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New York

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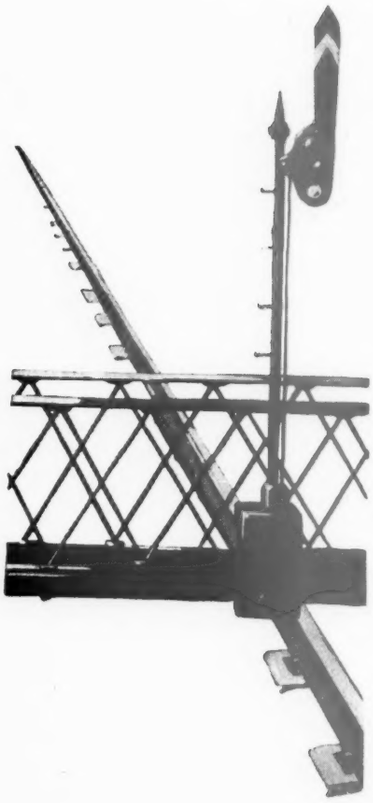

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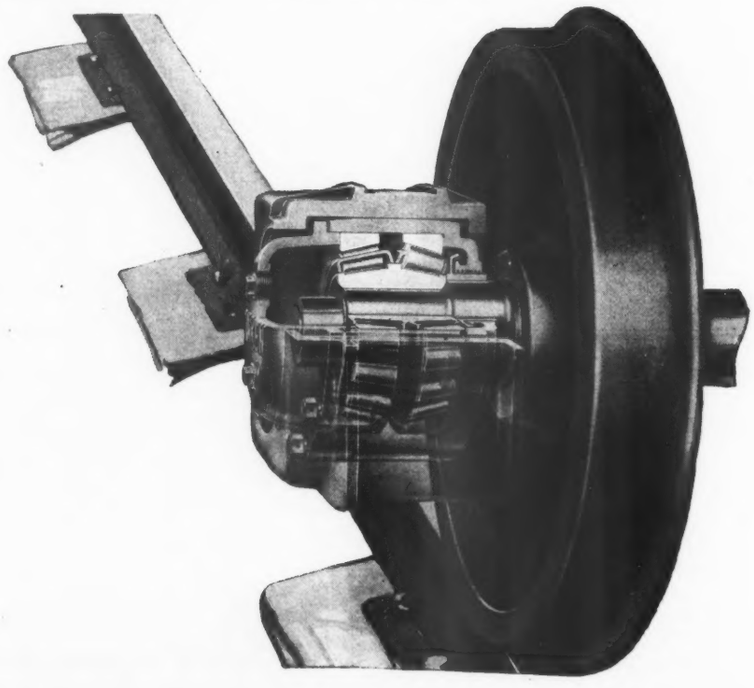


Railway Mechanical Engineer

Vol. 102 OCTOBER, 1928 No. 10

Federal locomotive defects must be corrected whenever and wherever found. The place to begin, however, is at the back shop as each locomotive goes through the shop for general repairs. With a thorough-going, workman-like job done here, the foundation is established for a period of 12 months, more or less, of effective service of the locomotives with maximum freedom from delays and interference with operation caused by the development of locomotive defects. This fact was strongly emphasized by A. G. Pack, chief inspector, Bureau of Locomotive Inspection, Interstate Commerce Commission, in a recent address before the International Railway General Foremen's Association at Chicago. Mr. Pack said, "Prevention is the first requisite in the orderly process of reduction or elimination of defects, and assuming that the builder and associated agencies have done their part, this must start in the back shop. . . . . So long as a locomotive is to be continued in use, it should be turned out after each general repair with unimpaired ability to handle its full tonnage on scheduled time." It is a generally recognized fact, which, however, cannot be stressed too often, that general repairs accompanied by detailed and careful preliminary and final inspections to check the quality of the work are, as Mr. Pack says, "a prime requisite in the process of eliminating defects."

Eliminating locomotive defects

A locomotive erecting shop recently was tied up almost seven hours by the failure of a 250-ton overhead crane. Investigation revealed that the shop cranes were inspected only at infrequent intervals. All cranes, especially those that are important units of the material handling systems, should be inspected daily. The defects shown on the inspection reports should be given immediate attention. The mechanical parts are subjected to severe service and wear is rapid. The crane trolley with its hoisting gear is especially important because of the severe service to which it is subjected. There should be spare parts in stock for all bearings or other quick-wearing parts, also for any electrical parts that may burn out. It is unwise to overload a crane; it is dangerous to the workmen below and contributes to rapid wear of the gear train, and the practice should not be tolerated. The lubrication of all working parts and bearings is important and should be attended to regularly. The use of ball or roller bearings reduces the amount of labor necessary for attending to lubrication. Particular attention should be paid to the cables because they wear quickly. The rails on which the crane runs should be lined up regularly. Only by repairing small defects as they occur can crane equipment be maintained without breakdowns at inopportune times.

Maintenance of cranes

At frequent intervals word is passed around to shop foremen to clean up their departments preparatory to a visit from an officer or the directors. Such visitors are not usually keenly critical of details and unless some part of the shop shows unmistakable evidence of bad housekeeping, no comment of the visitor, except perhaps a general expression of approval, is even likely to be passed on to the foreman. This quite naturally confirms each one in his opinion that his own housekeeping is above reproach.

Unusual method of shop inspection

Recently, in a large railroad shop, the foremen were made to realize fully that each had something to learn as to what constitutes good shop housekeeping. The usual word was passed to the department foremen to be prepared for a visit to be made on a Saturday morning by the chief mechanical officer. The officer did not appear, but the foremen were asked to meet at the shop superintendent's office directly after lunch. When they were assembled, each foreman was assigned to inspect a department other than his own, with instructions that he make out a complete written report as to the conditions found. They also were requested to include in their reports any particularly effective methods of keeping a shop clean, of providing safety for the workmen, or any other practical ideas they might find that could be generally used throughout the shop. The foremen were assured that this unusual procedure was to be carried out in a friendly spirit for the mutual benefit of the entire staff and of the shop as a whole and that nothing in any of the reports would be held against any of the foremen. With this assurance, the members of the staff entered into the plan wholeheartedly, each realizing that he would derive some benefit from the final results.

Each foreman made a thorough inspection of the department to which he was assigned and submitted a complete report of his findings and recommendations. Each foreman received a copy of the report concerning his own department. In addition, a committee, selected by the shop superintendent, studied the reports and recommended that certain practices be adopted throughout the shops. These recommendations were practically all put into effect. Each of the foremen found that he had much to learn about keeping a shop clean.

Most foremen take a personal pride in their shop but, owing to their many other more important duties, tend to neglect their housecleaning responsibilities, with the result that they are apt to get into a self-satisfied rut.

Perhaps there are other shop superintendents who find that their foremen are neglecting to give proper consideration to methods of good housekeeping as applied to railroad shops. Perhaps the method of inspection mentioned in the above paragraphs would prove beneficial to such foremen.

Reducing fatigue in truck repairs

One of the most tiresome jobs either in a car or locomotive repair shop is repairing trucks, especially if the work is done on the floor instead of over a pit. Considering the fact that most of the work on car, engine and tender trucks is performed while the trucks are removed from under the equipment, there is little reason for a man having to crawl around on his back on the floor underneath a truck. One railroad has recognized the effect of such fatiguing work on production, and is now installing the necessary equipment and facilities to get truck work up to what is termed "bench height". In one of its car shops, it has made use of a number of scrap truck arch bars, which are inverted and secured to the floor, thus serving as trusses on which the rails of the truck repair track are bolted. Trucks to be repaired are run up on the raised track where they are at a convenient height and location for the workmen. This study is being extended to other jobs with the object of getting as much work off the floor as possible. This recognition of fatigue as a factor in car and locomotive repair work is important. A good feature in connection with the installation of "bench height" facilities, is that it can be done in the majority of cases with scrap material. In other words, much of the elimination of fatigue can be made to pay a big return on a small investment.

Machine tool fundamentals

Railroads must make their own special small tools which are not required in sufficient quantities to make it profitable for supply companies to manufacture them. It pays to discuss tool problems with the manufacturers who are specialists in their respective lines. Tools should not be made with greater refinements in design than needed for the particular work in hand. Expensive high production tools should not be purchased for outlying shops and enginehouses where quantity production is not required.

These and numerous other points were ably touched on by D. C. Curtis, chief purchasing officer of the Chicago, Milwaukee, St. Paul & Pacific, at the sixteenth annual convention of the American Railway Tool Foremen's Association held at Chicago, September 12-14, inclusive. One paragraph in particular is notable because of its authoritative statement about obsolescence Mr. Curtis said, "The tendency in railway tool design is to make tools that will not wear out. This practice is not always sound. A tool should be made so that it will produce a profit for its user. It should be made to last only a reasonable length of time and pay a dividend in that time. Some of the most successful users of tools, particularly in production work, build their tools only for a life of five years, during which the tools must pay for themselves. This enables the user to take advantage of the improvements that are so rapidly being made, or to discard the tool without loss if conditions change so that it is no longer needed." The justification for continuing any machine tool in service for the sole reason that it is still in condition to run and perform its original function is amply refuted by this statement.

As indicated by Mr. Curtis in another part of his address, it is highly profitable to appraise machine operation on facts and a real knowledge of costs rather than on personal opinions, as is now sometimes the case, and a foreman possessed of this information is much more apt to get the machines he desires. The additional suggestions of Mr. Curtis regarding budgeting tool room expenses, consolidating requisitions for tool parts, etc., deserve careful consideration in the interests of more efficient shop operation.

Progress in equipment painting

Railroad men, as a general rule, are inclined to be conservative in their attitude toward new developments in their field, particularly where such developments are radical in nature and involve decided changes in materials or practices. This conservatism evidenced itself when the use of lacquer for finishing cars and locotives first attracted attention, and observers at the 1926 meeting of the A.R.A. Equipment Painting Section at Detroit might have felt that members of that section carried this characteristic to the point of narrow-mindedness in apparently opposing the use of this modern finish. Such, however. was not the case, and their position has proved to be of inestimable value, not only to the railroads but to the finish manufacturers. In the intervening period, the railroads have learned a great deal about lacquer and the necessity of overcoming the early objections to its use has contributed to a remarkable development not only in this type of finish, but in finishing methods as well. At this year's meeting of the Equipment Painting Section at Montreal, lacquer and its application occupied the center of the stage and, while it can not be said that there is a widespread move to adopt this finish, there was in evidence a decided willingness to consider its advantages and to learn more about the problems which must be solved before its general application may be carried out with complete success.

Lacquer has several advantages, among which are the ease of application and the saving in shop time because of its rapid drying properties. As to its durability, service tests on both cars and locomotives seem to indicate that a somewhat longer life may reasonably be expected. As to its cost, that is something that can be decided only after taking several factors into consideration. The principal obstacles to its general adoption, aside from the fact that it is yet comparatively new, seem to be the question as to whether or not its use constitutes a detriment to the health of the workmen and the more important fact that it does introduce a fire hazard. Both of these factors were discussed at length during the Montreal meeting, with the result that information was brought out to the effect that the elimination of benzol from lacquer has removed the danger of ill effects on the health of workers, and that the fire hazard can be reduced to a negligible quantity by the installation of proper shop equipment and strict attention to certain safety measures, some of which are desirable, if not essential, where other finishes are used. The groundwork for the use of lacquer has been laid and the committees of the Equipment Painting Section are to be commended on the fund of valuable information that has been placed on record in the proceedings of the 1928 meeting. The road to a more durable and less expensive finish for railway equipment seems to be quite

clearly defined, and the real value of the information already brought to light is that is may be used as the basi of an intelligent consideration of the possibilities of this modern finishing material by those roads that have not yet experimented with its use.

The A.R.A. loading rules

A letter commenting on an editorial published in the June 27, 1928, issue of the Daily Railway Age appears on the Reader's Page of this issue, in which the writer makes a number of suggestions concerning the arrangement of the loading rules book. The writer does not agree with the statement in the editorial to the effect that the present book of loading rules is serving its purpose quite efficiently in its present form and gives reasons to show that it is not only cumbersome, but inconvenient as a reference book for the use of the inspector. The Bureau of Explosives pamphlet No. 9, to which he refers as an improvement over the A.R.A. loading rules book, is 4 in. by 8 in. and contains 377 printed pages. This number does not include a considerable number of drawings, printed on a tough quality of thin paper, which are inserted between the pages containing the text to which the drawings refer. The A.R.A. loading rules book is 5 in. by 7½ in. and has 259 printed pages. The drawings are included in the text matter.

Many of the drawings in the loading rules book occupy a full page each, and as many as twelve to thirteen of these full-page drawings are printed on consecutive pages. As is pointed out in the letter this arrangement frequently requires the exasperating necessity of having to leaf over a number of intervening pages in the process of reading a particular rule. Undoubtedly the arrangement of the book as a handy means of reference could be improved by grouping at least the full-page drawings in the back of the book.

The suggestion of the writer that the Committee on Loading Rules make one general rule confined to the requirements applying universally to all classes of loading and then repeat each rule of less than universal application in the rules of each group to which it applies, will, if carried out, greatly reduce the number of cross references which must be looked up by the interchange inspector who has not committed the rules to memory, before he can, with confidence, pass on the correctness of the loading of the great variety of commodities covered by the rules, many of which come to his attention only occasionally. This increase in convenience, however, would probably cost some increase in the size of the book.

Our correspondent has first-hand knowledge of the problems of the interchange inspector and may be pardoned for giving greater weight to the convenience of the inspector than to that of the shipper. The latter, in most cases, is interested in the rules pertaining to a limited number of commodities and, when the requirements for loading these particular commodities have once been mastered, he has little need for further reference to the rule book. The interchange inspector, on the other hand, must, at one time or another, check the correctness of the application of every rule in the book and must do it, one may say, on the spur of the moment.

The real question raised by our correspondent is whether the objective of the committee, in its arrangement of the rules, should be the minimum requirements of the shipper, or the maximum convenience for the railroad inspector. Should this question be answered in favor of the inspector?

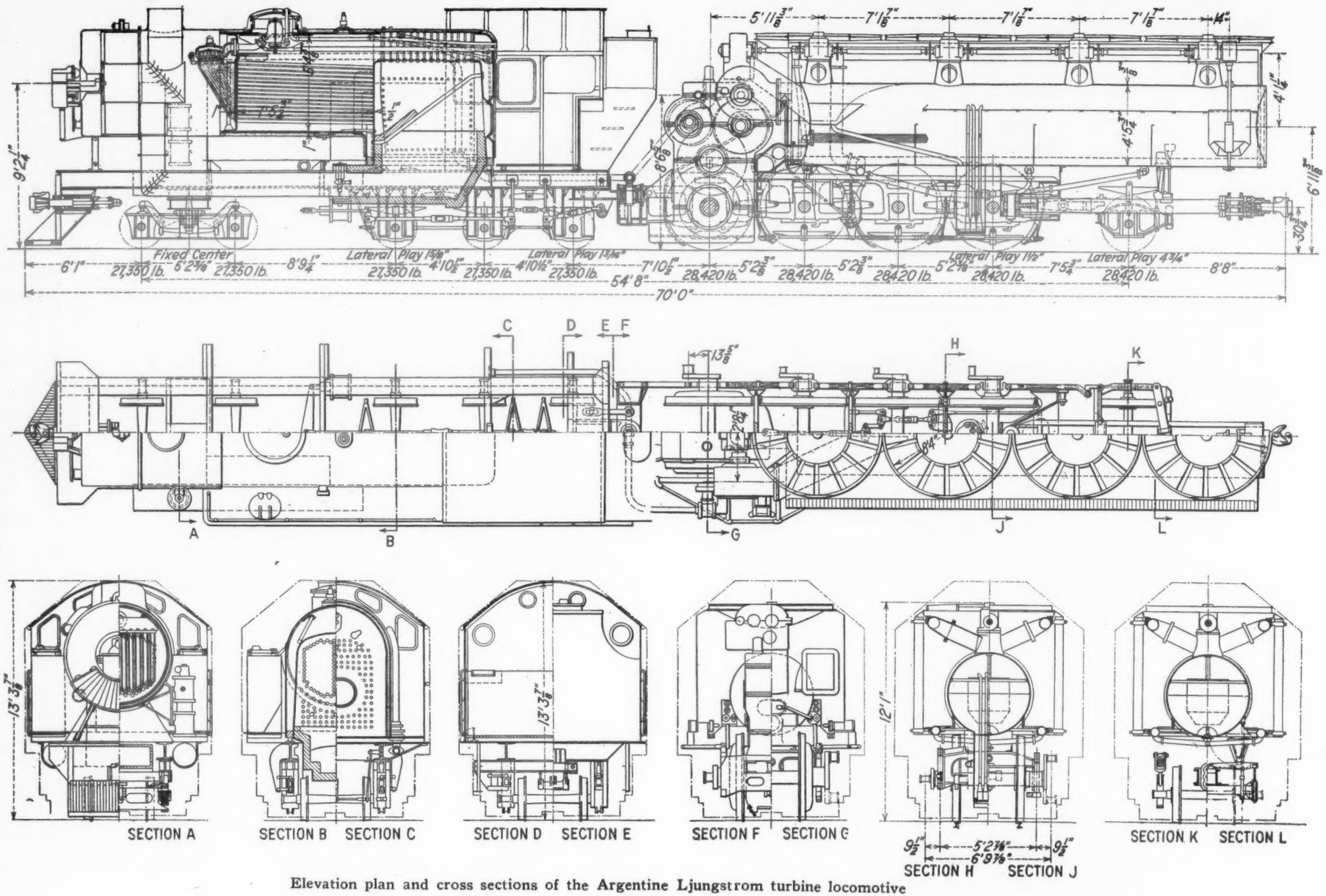
A month of conventions

Since the printing of the September issue of the *Railway Mechanical Engineer*, conventions have been held by the American Railway Tool Foremen's Association; jointly by the Railway Car Department Officers' Association and the Southwest Master Car Builders' and Supervisors' Association; by the Equipment Painting Section of the Mechanical Division, American Railway Association; by the International Railway General Foremen's Association, and by the Traveling Engineers' Association. There are few of our readers who have no interest in the problems dealt with by any of these associations, and we believe that most of our readers are vitally interested in some of the problems dealt with by at least one of these associations. To report the proceedings of all of them, even confining ourselves to a selection of those subjects in which the interest is most general, requires the major portion of the space available in this issue. It becomes, therefore, essentially a convention issue.

Some of the convention reports deal with matters of interest specifically to both car department and locomotive department supervisors, and the retention, therefore, of our customary Car Department and Shop Practice headings would prove misleading to our readers. For this issue we have, therefore, dispensed with these departmental sub-divisions of the material in the paper and, while the articles have been arranged without regard specifically to their departmental appeal, we believe all of our readers will find their interests no less adequately served for that reason. In addition to the proceedings of the associations already mentioned, there will be found an excellent paper which was presented at the convention of the International Railroad Master Blacksmiths' Association held just prior to the closing of the September issue.

The holding of conventions of six associations dealing with various phases of the problems of equipment, maintenance and operation within a period of but little more than a month tends to focus the attention of all officers and supervisors of the mechanical department on the subject of association work in general and, no doubt, leads many officers to ask themselves whether these numerous associations are really justified by the results which they produce.

This question can only partially be answered by a study of the various proceedings printed in this issue. This statement does not imply that the programs of any of these associations were lacking in addresses of inspirational value or in papers and committee reports containing recommendations or suggestions of practical value. Inspiration, broadened knowledge, and suggestions for improved practice are in themselves of no value, however, until they have been applied in such a way that the supervisor who has had the benefit of them can be seen to be a better and more effective man for his job as a result of his participation in the work of his association. No member of any of these associations who has its interests at heart will allow the year to pass, therefore, without making an earnest effort at a practical demonstration of the value of his association in the everyday conduct of his duties. Better shop practices, or better car and locomotive conditions, or more efficient maintenance expenditures, or a more aggressive and more intelligent fight for improved facilities, or smoother employee relations, or better judgment in the selection of materials or, perhaps, all of these things combined will be sure to follow.



Elevation plan and cross sections of the Argentine Ljungstrom turbine locomotive

The Ljungstrom turbine locomotive

Designs developed for the Argentine State and Swedish State Railways and London, Midland & Scottish represent latest construction

Ljungstrom turbine locomotive leaving Tafi Viejo, Argentina, with a fast train

ELEVEN years ago, the brothers, Frederick and Birger Ljungstrom, started work on the development of a complete design of turbine locomotive, which finally resulted in the building of what has been known for a number of years as the first Swedish Ljungstrom turbine locomotive. This locomotive, descriptions of which have been published in these columns, was constructed by Aktiebolaget Ljungstroms Angturbin, Stockholm, Sweden, in 1921. It was built primarily for experimental purposes and has been put through a large number of road and plant tests since its construction.

The latest developments of the Ljungstrom turbine locomotive are the 2,000-hp. express turbine locomotive built by Messrs. Beyer, Peacock & Co., Ltd., Manchester, England, which has been running in regular service on the Midland Division of the London, Midland & Scottish Railway since July, 1927, a 1,750-hp. freight locomotive built by Nydquist & Holm, Trollhattan, Sweden, for the Argentine State Railways, and an 1,800-hp. express locomotive for the Swedish State Railways, which was also built by the latter company. The design and construction of the English locomotive is similar in many respects to that of the Argentine locomotive, except that the former is standard gage and burns coal, while the latter is meter gage (3 ft. 3½ in.) and uses oil for fuel. The results of the experiences with the first locomotive were embodied in all three of the new designs, and as a result they differ considerably in details and appearance.

The Ljungstrom locomotive built for the Argentine State Railways

One of the drawings shows the elevation, plan and a number of cross sections of the Ljungstrom turbine locomotive, which was delivered to the Argentine State Railways for trial in freight service in 1925. Previous to shipment, however, this locomotive was tested on a specially built testing plant, located at the works of Messrs. Nydquist & Holm. This plant was built only for testing the mechanical features of the locomotive, and for establishing the capacity of the boiler and condenser. The boiler was fired with an oil-firing apparatus of Ljungstrom design, and the first tests were made to ascertain its reliability. The builders succeeded in obtaining satisfactory combustion, and a boiler efficiency of 87 per cent in these tests. The test on the condenser was also satisfactory.

These tests, however, were discontinued on September 24, 1925, the time for delivery being overdue, and the locomotive was shipped on October 14, 1925, to Buenos Aires, where it was reassembled in the locomotive shops of the Argentine State Railways at Tafi Viejo. The work of assembly was completed in February, 1926, at which time road tests were inaugurated. No road tests were made in Sweden because of the lack of meter-gage track.

Road tests in Argentine

A number of preliminary trips of short duration were made in February and March, 1926, for the purpose of adjusting the mechanical details and also to adjust the oil burners to the quality of fuel oil used by the Argentine State Railways. The fuel oil used in that country is considerably heavier than that used in Europe. However, only a few alterations to the oil burner apparatus was necessary for it to handle the heavier oil satisfactorily.

On March 13, 1926, the first test was made over the Tucuman and Santa Fe line, over which the locomotive was to be used in regular freight service. This line has a gradual slope from Santa Fe to Huyamampa,

which is about 415 miles from Santa Fe. From Huyamampa to Tucuman, a distance of a little over 82 miles, the line passes through the first approaches of the Andes Mountains and Tucuman is about 740 ft. above Huyamampa. The builders guaranteed an oil consumption of 50 per cent of that consumed by the piston type locomotives purchased in 1924. This fuel saving, however, was only guaranteed during the cold season of the year. During the hot season, when the transfer of heat through the surfaces of the air-cooled condenser is reduced, the guarantee was reduced to 40 per cent. The water consumption was guaranteed to be 52.8 gal. per hour.

Comparative table of dimensions, weights and proportions of the three latest Ljungstrom turbine locomotives

Railroad	Swedish State	Argentine State	London, Midland & Scottish
Builder	Nydquist & Holm	Nydquist & Holm	Beyer, Peacock & Co., Ltd.
Service	4 ft. 8½ in.	Freight 3 ft. 3½ in.	Express 4 ft. 8½ in.
Track gage			
Weights in working order:			
On drivers	110,000 lb.	113,680 lb.	108,000 lb.
On front truck	56,400 lb.	54,700 lb.	52,200 lb.
On intermediate truck	105,000 lb.	72,050 lb.	87,200 lb.
On rear truck	44,000 lb.	28,420 lb.	38,600 lb.
Total engine	315,400 lb.	268,850 lb.	286,000 lb.
Wheel bases:			
Driving	60 ft. 8¾ in.	54 ft. 8 in.	63 ft.
Total engine	74 ft. 9⅝ in.	70 ft.	73 ft. 11 in.
Wheels, diameter outside tires:			
Driving	60 in.	58 in.	63 in.
Front truck	———	———	39 in.
Intermediate truck	———	———	39 in.
Rear truck	———	———	39 in.
Boiler:			
Type	Straight top	Straight top	Belpaire
Steam pressure	280 lb.	280 lb.	300 lb.
Fuel, kind	Coal	Oil	Coal
Diameter, first ring, inside	———	———	72 in.
Firebox, length and width	———	———	65 7/16 in. by 65 11/16 in.
Tubes and flues, number and diameter	———	———	228—2½ in.
Length over tube sheets	———	———	9 ft. 6⅝ in.
Grate area	33 sq. ft.	———	30 sq. ft.
Heating surfaces:			140 sq. ft.
Firebox	127 sq. ft.	129 sq. ft.	1,480 sq. ft.
Tubes and flues	1,180 sq. ft.	950 sq. ft.	1,620 sq. ft.
Total evaporative	1,307 sq. ft.	1,079 sq. ft.	640 sq. ft.
Superheating	785 sq. ft.	615 sq. ft.	2,260 sq. ft.
Comb. evap. and superheat.	3,092 sq. ft.	1,694 sq. ft.	———
Miscellaneous data:			
Water capacity, boiler	———	11,050 gal.	———
Water capacity, condenser	———	12,150 gal.	———
Cooling surface, condenser	12,900 sq. ft.	12,900 sq. ft.	———
Air preheater, heating surface	8,600 sq. ft.	8,600 sq. ft.	6 tons
Fuel capacity	9 tons	14,300 gal.	75
Maximum speed, m.p.h.	56	40.5	36,000 lb.
Tractive force	32,800 lb.	33,000 lb.	2,000
Max. hp. rating at rail.	1,800	1,750	
Weight proportions:			
Weight on drivers ÷ total engine weight, per cent	35	42.2	37.8
Weight on drivers ÷ tractive force	3.36	3.44	3.0
Boiler proportions:			
Tractive force ÷ comb. heat. surface	15.7	19.5	15.94
Firebox heat. surface ÷ grate area	3.85	———	4.67
Comb. heat. surface ÷ grate area	63.5	———	75.4
Firebox heat. surface, per cent of evap. heat. surface	9.65	11.95	8.64

This fuel and water consumption of the turbine locomotive had to be calculated from the results taken from four official tests, one made during each season of the year. Of the 500 miles lying between Santa Fe and Tucuman, approximately 250 miles is through desert country in which the water supply and facilities are not adequate for locomotive purposes. As a result, piston locomotives are required to haul about 24,000 gal. of water in the train, not including the supply on the tender. In addition, the water supply outside of this desert area was such as to cause rapid corrosion in the boilers, which in several instances, resulted in serious explosions.

The results of the four test runs, especially from the standpoint of water consumption, showed that the turbine locomotive was well fitted for service in desert country and in territories where the water supply was bad for steam generation. The total water consumption of the turbine locomotive was sufficiently small so that all the water required for leakage losses could readily be evaporated before being delivered to the locomotive. No deposit was found in the boiler at the end of the trial year. However, silt and other impurities in the water had, in some instances, caused trouble, especially in the tubes of the superheater. This difficulty was eventually corrected, as the superheater tubes had been constructed with too small a diameter, and had a tendency to become plugged.

Summary of four road tests with the Argentine Ljungstrom locomotive between Tucuman and Santa Fe

Road test	Date	Air temp., deg. F.	Vacuum, in.	Water consumption, gal. per hr.	Oil consumption, lb. per 1,000 t.m.	Average train weight, tons
1	March 23-25, 26	83	21.5	44	31	920
2	June 13-15, 26	*	*	48	38	920
3	Sept. 17, 19, 26	88-66	*	41	27	1,600
4	Nov. 23-25, 26	100-86	16-22	48	35	1,320

* Not indicated in the report.

From the standpoint of performance, the tests showed that the turbine locomotive could start and haul heavy trains with comparative ease. This feature is particularly advantageous in Argentine, owing to the fact that heavy freight traffic is of a periodic nature. In certain seasons of the year, the sugar business is heavy, which, in addition to the regular freight traffic, throws a considerably increased burden on the railroad. During the past year, the turbine locomotive has been of considerable assistance in relieving congestion at intermediate terminals.

Data obtained from the four official road tests between Tucuman and Santa Fe, and also the results of comparative test runs between Clodomira and San Cristobal, with a piston type locomotive and the turbine locomotive, are shown in two of the tables. The distance between Clodomira and San Cristobal is 274 miles.

Results of three road tests for fuel consumption made with the Swedish experimental locomotive in 1921

Date of test	July 27	Aug. 12	Aug. 16
Speed of the locomotive, m.p.h.	36.4	37.6	39.6
Brake horsepower	484	478	524
Loss in brake, bearings, gears, circulation pump and fans, hp.	179.5	189.5	205
Output of turbine, hp.	662	670	728
Coal fired per hour, lb.	916	980	1,028
Coal consumption per turbine hp. per hr., lb.	1.37	1.46	1.39
Heating value of coal, B.t.u. per lb.	13,075	13,075	13,030
Heat quantity in coal per turbine hp., per hr., B.t.u.	17,880	19,200	18,100
Thermal efficiency in relation to turbine efficiency, per cent	14.04	13.13	13.82

The Argentine State Railways aim to operate with as long trains as the construction of the station platforms, and terminal and yard tracks permits. Trains up to 1,800 tons were hauled on the four official test runs.

Results of comparative tests with the Ljungstrom turbine and a piston type locomotive

	Piston type locomotive	Turbine locomotive
Total water consumption, gal.	24,200	1,100
Water consumption per 1,000 ton miles, gal.	92	3.14
Saving in water per run, per cent	.....	95.5
Saving in water per 1,000 ton miles, per cent	.....	96.6

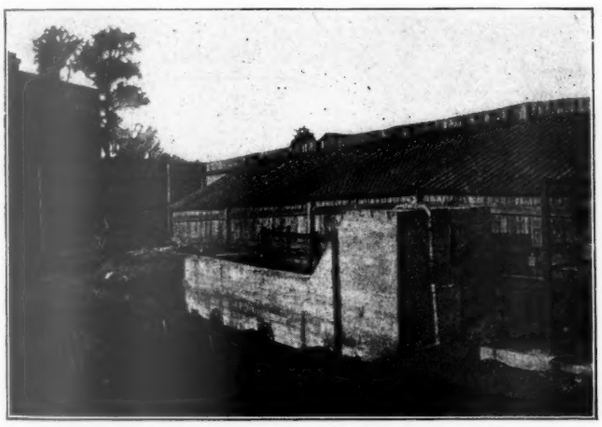
It is believed that the elimination of the tank portion of the tender, together with the extra water which has to be carried in the train and which is made practicable with the Ljungstrom turbine locomotive, a consider-

able increase can be obtained in effective ton-miles per year.

Tests with first Swedish locomotive provide valuable data for future developments

In February, 1923, negotiations were completed with Messrs. Nydquist & Holm, and Messrs. Beyer, Peacock & Co., Ltd., Manchester, England, for the building of Ljungstrom turbine locomotives. Shortly after the license agreement with these two companies was completed, Nydquist & Holm received orders for an express locomotive from the Swedish State Railways and a freight locomotive from the Argentine State Railways. Then Messrs. Beyer, Peacock & Co., Ltd., received an order from the London, Midland & Scottish.

Both the Swedish and Argentine locomotives contain many similarities in design. The new Swedish Ljungstrom locomotive develops 2,000 hp. and carries a boiler pressure of 280 lb. The wheel arrangement differs from that of the first Ljungstrom locomotive in that it has a four-wheel, instead of a two-wheel truck at the rear, the rear unit being of the 0-6-4 type. The Argentine locomotive rear unit has four driving axles and a two-wheel truck. The front units in all three locomotives carry no drivers in this unit.



Test plant used for testing the first Ljungstrom turbine locomotive

For purposes of comparison, the results of three road tests for fuel and water consumption, which were made with the Swedish experimental locomotive in 1921, are shown in one of the tables.

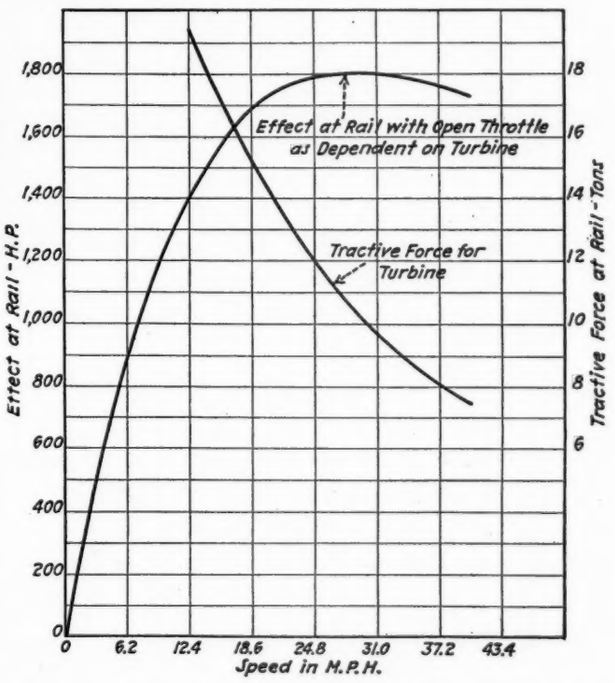
These tests were run between Stockholm and Upsala, a distance of 81.77 miles, and between Hagalund and Upsala, 34.18 miles. Owing to the uncertainty of defining the losses in the brake arrangement, gears, etc., the economy tests conducted in Sweden were not as exact as were desirable. However, these tests showed a coal consumption of 1.37 lb. and 1.46 lb. per turbine horsepower-hour, at a speed of over 37 m.p.h. Two additional runs were made, after the weak points in the design had been corrected, that showed a somewhat lower consumption of fuel. Immediately after the completion of these tests, the first Swedish turbine locomotive was placed in regular service.

No test data on the new express locomotive, built by Nydquist & Holm for the Swedish State Railways, are available. It is also a coal burner as was its predecessor.

A comparison of the turbine locomotives

A comparison of the principal dimensions, weights and proportions of the three locomotives built by Nydquist & Holm, and Beyer, Peacock & Co., Ltd., is given in one of the tables. It will be noted that a considerable portion of the total weight is distributed over wheels, other than the drivers, which gives a lower ratio of weight on the drivers to the total weight than is ordinarily obtained on locomotives of the piston type. The factor of adhesion of the Swedish State Railway's locomotive, is 3.36, the tractive force being 32,800 lb. The Argentine State Railway's locomotive exerts a tractive force of 33,000 lb. and has a factor of adhesion of 3.44. The L. M. & S. locomotive has a tractive force of 36,000 lb. and a factor of adhesion of 3.

Another feature of the turbine locomotive, as will be noted from two of the charts, is its large starting torque. The starting torque of a turbine is practically double the torque developed at its maximum efficiency. The Ljungstrom turbine locomotive is designed so that the starting torque can be increased as desired, by cutting out the high-pressure stages of the turbine. The turbine is designed expressly for locomotive work. The turbine and gear drive produces uniform torque, with absence of unbalanced wheel impact loads on bridges and track. The fact that the turbine locomotive is especially suited for long runs without taking water, appears to give it an advantage in bad water territory. This feature makes practicable a choice of feedwaters, and a possible reduction in the number of feedwater treating plants.



Effect at the rail and turbine tractive force curves taken from the Argentine tests

Turbine locomotive includes the operating features of a power plant

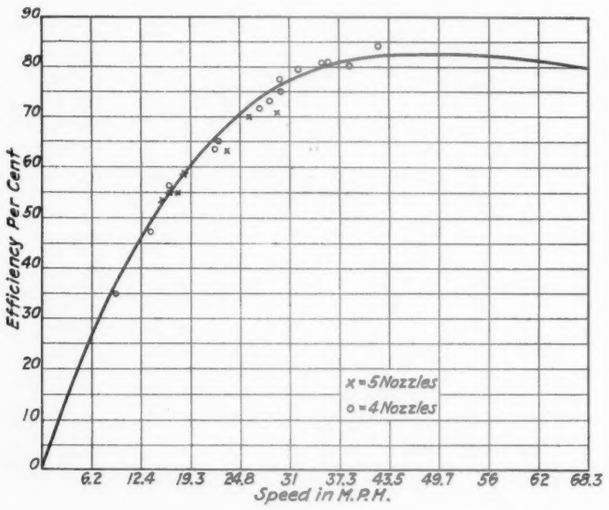
The complete locomotive, as shown in one of the drawings, consists of two separate sections of nearly equal wheel base, coupled together. The leading section constitutes the boiler plant, while the turbine, the reduction gearing and the condenser, are carried by the rear section which is mounted on three driving axles and a trailer truck. Since all the steam is condensed, the necessary draft is provided by a turbine-driven fan. This is located on the front of the smoke box and ahead

of the stack so as to provide space for the air preheater.

The air preheater

Referring to the elevation plan and cross-section drawings of the Argentine Ljungstrom turbine locomotive, the arrangement of the air preheater has been considerably changed from the design used in the original Ljungstrom locomotive. A description of this locomotive was published in the October and November, 1922, issues of the *Railway Mechanical Engineer*, pages 557 and 623, respectively. A later article, which described briefly the locomotive order for the Argentine State Railways, was also published in the August, 1923, issue, page 557.

The first preheater was of the tubular type. All recent preheaters on Ljungstrom locomotives have been of the rotative regenerative type. This consists of a rotating drum placed at the front of the smokebox. In-



Turbine efficiency of the Swedish Ljungstrom turbine locomotive calculated from tests made September, 1923

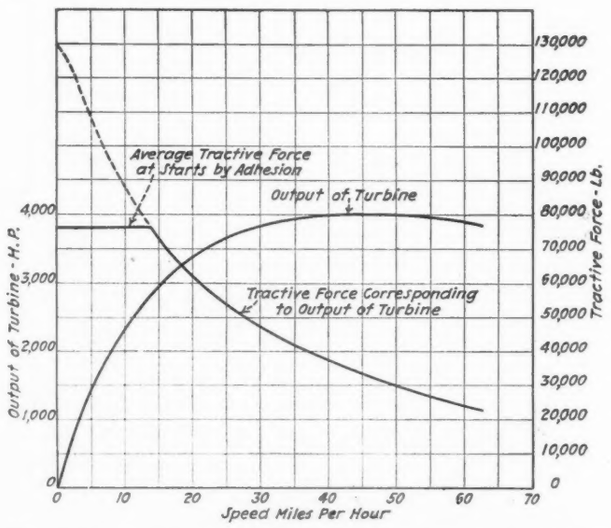
side of the drum is a checker-work of steel plates. The flue gases from the boiler pass forward through the upper half of the drum, transferring heat to the steel plates, and are forced by the exhaust fan into a duct leading back through the center of the preheater drum to the stack. Air passes through the lower half of the rotating drum, is heated, and then passes through a steel duct which conducts it from the smokebox, below the boiler, to a closed ashpan. The operation of the preheater is thus continuously regenerative and this principle, combined with the counter-flow of gases and air, results in much higher efficiency of the preheater than was formerly obtained with the tubular heater.

The main turbine used for driving the locomotive is located on the front of the rear section. The turbine used on the first Ljungstrom locomotive was of the impulse reaction type, with axial steam flow. It developed 1,800 b.hp. at a maximum speed of 9,200 r.m.p., which corresponds to a locomotive running speed of 68.3 m.p.h. The torque was transmitted through a double reduction gear, with a ratio of approximately 22 to 1, which brought the rotative speed of 9,200 r.p.m. of the turbine down to 420 r.p.m. for the low speed gear.

The turbine used on the three latest constructions operates at a higher speed than the original design. The maximum speed of the rotor of the turbine on the L. M. & S. locomotive is 10,500 r.p.m., which corresponds to a locomotive speed of 75 m.p.h. and (with full steam pressure) an output of 2,000 b.hp. The torque is transmitted to the leading driving axle through triple reduction gearing housed in the casing, the arrangement of which is shown in one of the drawings.

Changes in construction from the first experimental locomotive

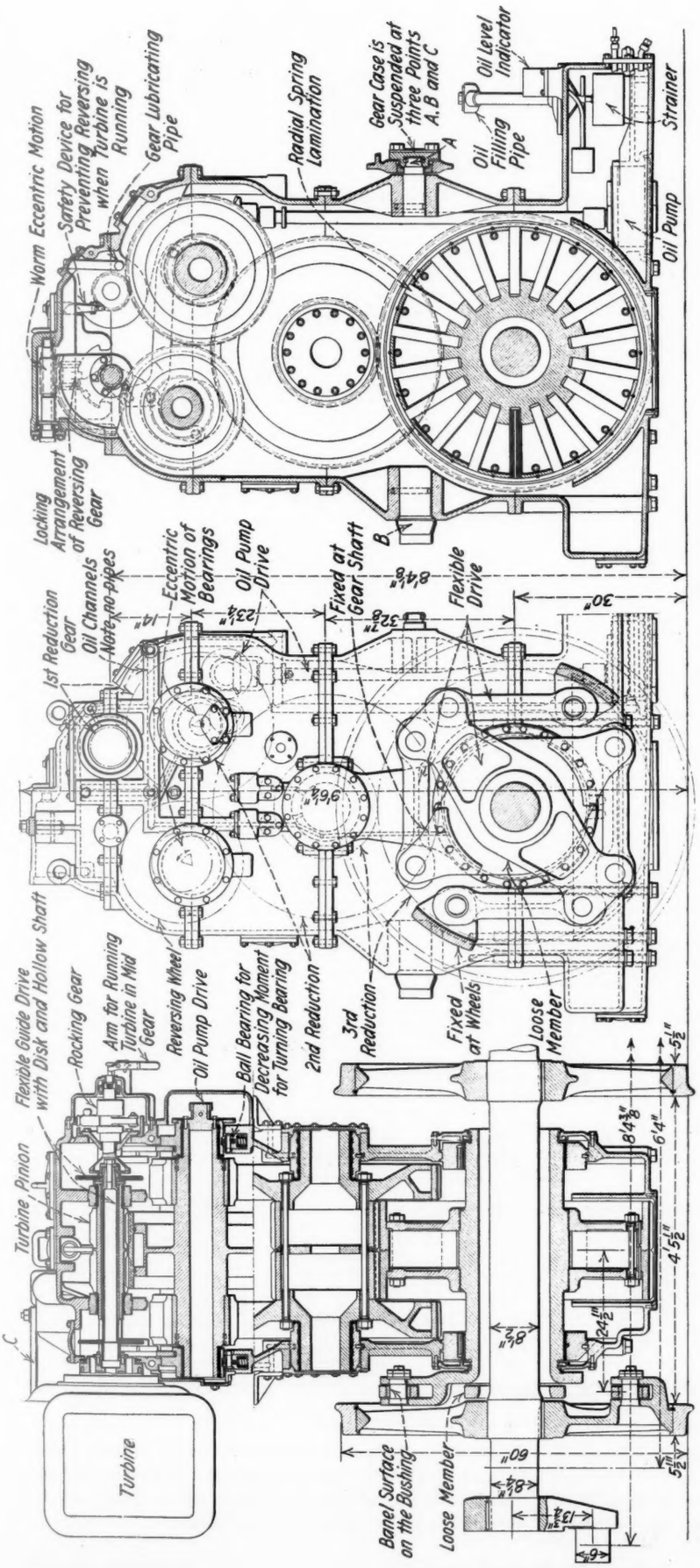
On the first experimental locomotive, the condenser fans were placed below the cooling elements, the cooling air being forced between the elements. This arrangement caused an uneven distribution of air. In the new design, the condenser elements are placed on both sides of the condenser and induced draft fans, instead of forced draft, are used, which effects better air distribution.



Theoretical turbine output and tractive force curves for a 4,000-hp. locomotive—Weight on the drivers, 260,000 lb.—Maximum speed, 62 m.p.h.

A number of alterations in the design of the gearing from the main turbine were also made. The gearing of the experimental locomotive was constructed with only double gear wheels, and reversing was accomplished by engaging and disengaging the cross-cut intermediate wheel. This wheel was manoeuvered by means of pistons adjusted by oil pressure. It was also possible in the early arrangement to raise or lower the blind shaft to suit the change of direction. The arrangement of the box and main gear drive used on the locomotive built for the Argentine State railways, which is similar to that used on the other two locomotives, is shown in one of the drawings. This drive is constructed with triple gearing and with a movable coupling shaft, which also serves as a driving shaft. Although it is more expensive than the blind shaft, it permits greater flexibility and greater accessibility when wheeling or unwheeling the locomotive in the shop.

Referring to the drawing of the box and main gear drive arrangement, the gears are in position for forward running of the locomotive. The pinions of the first reduction gears are in mesh with the second reduction gear, and the pinions of the latter are in mesh with the third reduction gear. The pinions of the third reduction gear complete the train of gears to the driving wheels. The double helical pinion on the shaft of the third reduction, meshes with a gear which is flexibly coupled to the driving axle. The rim of this gear



Box and main gear drive arrangement of the Argentine State turbine locomotive

is carried by radial spokes, which are built up of a number of leaves of spring steel, secured at their inner ends to the hollow shaft. The driving axle passes through the center of this shaft. One end of both hollow shaft is provided with two arms, 180 deg. apart. These arms are link connected to opposite ends of a loose member or beam through which the axle passes with ample clearance for oscillation. Each end of the floating member is in turn link connected to the driving wheel, these connections also being 180 deg. apart.

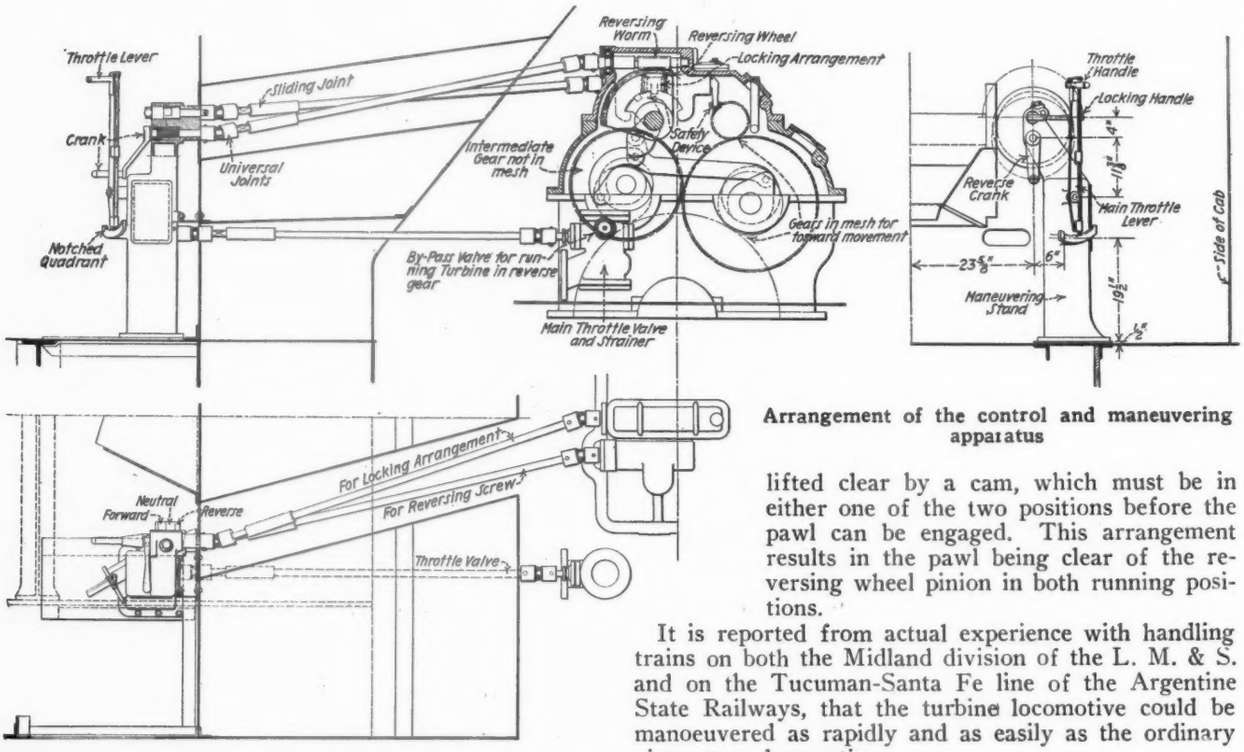
This system of links transmits the drive, but allows the driving axle to oscillate freely.

Reversing the Ljungstrom locomotive

Reversing the locomotive is accomplished by hand in the same manner as on a piston type locomotive equipped with a screw and crank reverse gear. This gear acts on the eccentrics, the location of which is shown in the center view of the drawing of the main gear drive arrangement. It will be noted that the reversing wheel and its pinion are shown completely out of gear. Both the reversing wheel and first-reduction gear being mounted on eccentrics, reversal of motion can be effected by rotating these eccentrics, which are operated by the screw reverse shaft. As the eccentrics on which the first reduction gear are mounted are rotated, the pinions are raised out of mesh with the second reduction gear. The operation, however, is so designed that during the entire movement, the first-reduction gear remains in mesh with its pinion. The eccentrics on which the reversing wheel are mounted are rotated by the same motion of reverse gear handle. By this rotation, the reversing wheel is brought into mesh with the first reduction gear, while the pinions on the same shaft as the reversing wheel are simultaneously brought into mesh with the second reduction gear. Thus by the reduction of the reversing wheel, which is an idler gear, into the gear system, the direction of motion of the driving axles is reversed.

The present arrangement of the control and manoeuvering apparatus, shown in one of the drawings, is considerably simplified in comparison to the previous complicated oil apparatus. It has also proved to be more reliable. The change of gears is effected by the reverse crank, which is located just

above the main throttle lever. An interlocking gear is provided, which makes it impossible to move the reverse crank unless the throttle is completely closed, and the locomotive is brought to rest. Likewise, the throttle cannot be opened unless the reverse crank is firmly locked in one of its two extreme positions. Occasionally, the gear teeth may foul during the operation of changing gears, as sometimes occurs when operating the gear shift of an automobile. When this occurs, the motion of the reverse crank is reversed for a single turn. This automatically lowers a pawl between the reversing wheel gear and its pinion, which moves the reversing wheel gear a fraction of a pitch. Thus, on resuming the original direction of the motion of the reverse crank, the teeth fall into gear and at the same time, the pawl is lifted clear by a cam, which must be in either one of the two positions before the pawl can be engaged. This arrangement results in the pawl being clear of the reversing wheel pinion in both running positions.



Arrangement of the control and maneuvering apparatus

It is reported from actual experience with handling trains on both the Midland division of the L. M. & S. and on the Tucuman-Santa Fe line of the Argentine State Railways, that the turbine locomotive could be manoeuvered as rapidly and as easily as the ordinary piston type locomotive.

NICKEL STEEL APPLICATIONS.—"User Experience—The Key to Future Nickel Steel Applications," is the title of a 16-page booklet issued by the International Nickel Company, 67 Wall street, New York, outlining the latest phase in its work to increase the use of nickel alloy steel. The advertisements in this booklet are intended to indicate the potential market represented by future nickel steel applications.

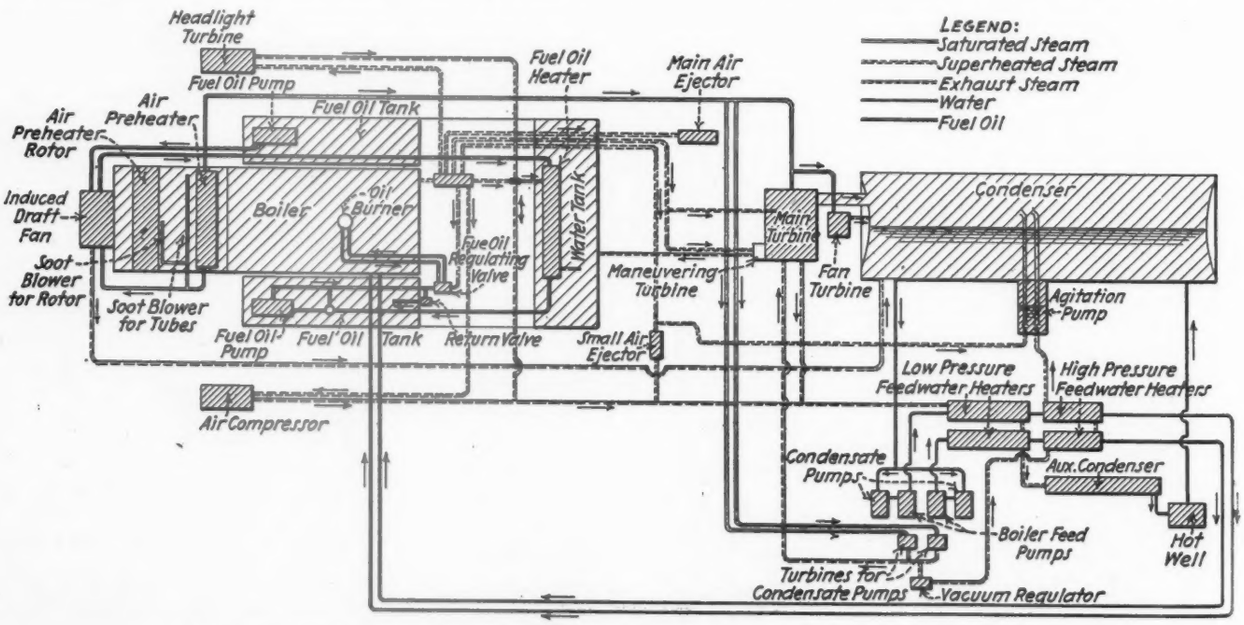


Diagram showing the scheme of operation of the Argentine State turbine locomotive

General foremen present constructive program

Speakers talk on problems of locomotive, car and stores departments and on human relations

DURING recent years the convention programs of the International Railway General Foremen's Association have proved to be of increasing interest and of broader educational value and this year's meeting, the twenty-second annual convention of the organization held at the Hotel Sherman, Chicago, September 18 to 21, demonstrated its value as a constructive element in the education of mechanical department supervisors in the broader problems of present-day railroad operation. The total registration—695, of which 178 were general foremen and 188 were railroad guests, indicates the ability of the organization to hold the interest of its own members while at the same it is attracting the attention of railroad officers and other supervisors.

The four-day program was arranged to include six sessions each devoted to a specific subject, on which an address was delivered by a speaker well known in railroad circles, and a committee report presented and discussed. The six sessions were devoted to the following phases of mechanical department activities and relations: Locomotive inspection; relations with the stores department; personnel relations; locomotive maintenance and operation; car operation, and car maintenance. On these subjects, in the order named, the following principal addresses were delivered and committee reports presented: "Reduction of Federal Defects" by A. G. Pack, chief inspector, Bureau of Locomotive Inspection, Interstate Commerce Commission; "The General Foreman's Responsibilities for Inactive Stock" by U. K. Hall, general supervisor of stores, Union Pacific; "The Heart of the Human Relations Problem" by Roy V. Wright, editor, *Railway Mechanical Engineer;* "The General Foreman's Contribution to Long Runs" by W. G. Black, mechanical assistant to the president, Erie; "How to Get More Car Miles Per Car Day" by E. J. Robertson, superintendent car department, Minneapolis, St. Paul & Sault Ste. Marie, and "Passenger and Freight Car Repair Classification" by W. E. Dunham, superintendent car department, Chicago & North Western.

F. M. A'Hearn (B. & L. E.) President

Election of officers

The following officers were elected to serve during the year ending September 1929: President, J. H. Armstrong (A. T. & S. F.); first vice-president, H. B. Sunderman (Hocking Valley); second vice-president, A. H. Keys (B. & O.); third vice-president, C. Y. Thomas (T. & Ft. S.); fourth vice-president, C. M. Hillman (M. & St. L.) and secretary-treasurer, William Hall, Winona, Minn. The retiring president F. M. A'Hearn was elected to the chairmanship of the executive committee together with the following members: C. A. Barnes (Belt Ry. of Chicago); H. E. Warner, (N. Y. C.); G. T. Boone (Canadian National) and W. J. McCloskey (Illinois Central).

The president's address

President A'Hearn, at the opening session, dwelt upon the fact that the general foreman must broaden his knowledge of his job to include an understanding that he is in reality an employee of the railroad company's stockholders and that he should feel the responsibility of so conducting his work as to contribute to the ability of the company to earn an increased return on its investment. In conclusion he said in part: "The purpose of a railroad is to furnish transportation and in providing this transportation, our efforts must be directed in such manner as to insure our employers, the railroad stockholders, an adequate return on the funds invested in our transportation systems. The general foreman is the trustee in both of those missions. Upon him depends the safe operation of the 59,600 steam locomotives on America's railroads today, as well as the 2,500,000 cars which must be so conditioned as to supply the now-frequent demand for more than a million weekly car loadings.

"It is generally agreed that the transportation offered by our railways is safer and more rapid than ever before, and that the standard of equipment maintenance is steadily improving. Faster and safer transportation will be continually demanded, and the general foreman must be depended upon to do his part.

"Gratifying results are not in evidence in the earning powers of the railway systems. The average return of 4.47 per cent on property investment shown in the year 1927 is far below what is expected and earned by capital invested in other industries. To do our part in securing a better return for the money expended in the providing of transportation is a goal worthy of our best efforts. Conservation of fuel, avoidance of damage claims, more careful supervision in the matter of repair materials, a higher standard of workmanship, and the extended use of labor saving appliances are among the means which may be used to show increased return for the railway dollar expended.

"Our purpose here today then, is to discuss frankly and freely the many problems which confront us and to anticipate as far as possible our problems of years to come."

Mr. Pack's address on the subject of "Reduction of Federal Defects" will be found elsewhere in this issue. Summaries of some of the other addresses follow:

The heart of the human relations problem

By Roy V. Wright
Editor, Railway Mechanical Engineer

Mr. Wright, in speaking on "The heart of the human relations problem" spoke in part as follows:

"We have not by any means reached the limit in the way of improved materials, equipment and facilities. There is still much to be done in eliminating preventable wastes and conserving our resources. There seems to be little doubt, on the other hand, but that the greatest possibilities for further betterment lie in improving the standards of supervision. This statement is not made in a spirit of criticism. The railroads have no apology to make in this respect when compared to other industries. Indeed, they are greatly to be commended because with forces so widely scattered the problem of management is far more complicated and difficult than in an organization whose plant and forces are concentrated in a comparatively small area. We might go even a step further and show that railroad managements have been leaders in many respects in improving their methods of supervision as compared to the average industry.

J. H. Armstrong
(A. T. & S. F.)
First vice-president

"The plain facts are that we have been projected into an industrial age with little time and opportunity to prepare for and face an entirely new set of conditions. The wonder is that we have been able to make such rapid progress in discovering and applying those principles upon which successful industrial management functions. That the industries of this country have been able to meet the situation as they have, is undoubtedly responsible for much of the material progress which its citizens as a whole enjoy today.

What is our goal?

"As supervisors, what is our goal? For purposes of discussion may we not assume that it is to encourage the greatest amount of intelligent and hearty teamwork among those working with us and to develop to the utmost the possibilities of each individual in the group—this to be done, not in a driving spirit, but as constructive leaders.

"This objective presumes an understanding of human nature and a considerable ability in the art of teaching. Do we possess these qualities, or, if not, can they be cultivated, and how? Is it not true that in the past too little stress has been placed on these qualifications in selecting foremen and supervisors, and too much on a man's ability as a craftsman?

"Again let us assume that a man was well qualified in these respects in the light of the conditions which existed at the time that he was promoted from the ranks. Industry as we know it today, is so new and is growing so fast, and the art of industrial management is still so far from being fully understood and appreciated, that even the best trained supervisors must continue to study in order to keep up with the best thought on the art of industrial leadership.

Concrete suggestions

"With this background, let us direct our attention to some of the concrete ways in which foremen and supervisors are being helped in getting a better understanding of their leadership functions.

"In the first place, one can gain much inspiration and help by comparing experiences in dealing with the human element with other foremen, and ways and means should be found to encourage more of such informal exchanges of experiences. One tendency in the right direction, which has been quite noticeable in recent years, is the greater stress which is being placed upon the holding of frequent and regular staff meetings of supervisors at important points. It is true that a large part of the programs of such meetings are given over to the consideration of routine and production matters, but it is true, also, that, more and more, questions concerned with human relations problems are coming up for consideration at such conferences.

"Another activity which has in most cases been suggested and organized by the foremen themselves and which has been growing by leaps and bounds in the past three or four years, is that of foremen's clubs. These are of course, conducted on a less formal basis in most cases than are the staff conferences, and ordinarily broader problems are discussed. Some of these clubs have quite definitely given a large place on their programs to questions concerning human relations, even going so far in some cases as to take up special study courses of foremanship training or industrial leadership.

"A still broader type of activity has been that of supervisors' clubs, including supervisors from all departments, rather than from one department, as is ordinarily the case with most of the so-called foremen's clubs. A group of this kind ordinarily schedules a still broader type of subjects for discussion and in some cases a considerable proportion of the topics relate to human relations problems. Incidentally, such clubs tend to humanize interdepartmental relations, thus minimizing departmental lines and intensifying the objectives of the organization as a whole.

H. B. Sunderson
(Hocking Valley)
Second vice-president

"In a few instances the foremen's or supervisor's clubs for a system or for a district as a whole are inter-related, at least to the extent of partially co-ordinating their programs and of having joint meetings once a year.

Leaders for foremanship training groups

"Much difficulty has been encountered, where a group

of foremen or supervisors deliberately set out to take up a study of foremanship training, in securing the right kind of leadership. Comparatively few men have been available who have made a thorough study of this question and are qualified to lead a study or discussion group. The lack of this sort of talent was so evident and was such an obvious handicap that an entirely new development has come about in the last few years, in that special training courses have been set up, the purpose of which is to provide an intensive training for those who seem best fitted by nature to undertake the leadership of foremanship training groups. Excellent results have been obtained. Naturally, some men have taken such courses who by nature or training are unfitted for the task, but in most cases men who have been reasonably adapted for such work have greatly profited from such courses and have given a good account of themselves in leading their local groups.

"The Federal Board of Vocational Training and the state departments of education, working under the Smith-Hughes Act, have been most helpful in vocational and foremanship training, although other agencies have also done most effective work. Among these are some of the industrial extension departments of state universities. There are, however, not a few other sources of information and inspiration, including a number of good books on foremanship training, industrial leadership and management, and personnel administration. The technical periodicals have also given much attention to these subjects, so that there are now a number of valuable helps available for individuals or groups that wish to perfect themselves in the understanding of industrial leadership.

"As indicated above, a prime requisite of a foreman or supervisor is that he should be a teacher or educator. We are seeing today, for instance, as we never have before, the necessity of following up the training of the worker throughout his entire service life. We are only just beginning to realize the possibilities in this direction.

The younger men

"Apprentice training has also taken on a new life and is being faced with renewed vigor on many roads. Hand in hand with this has come the appreciation that more attention must be given to selecting the boys as they enter the service, and to seeing that they are assigned to those classes of work for which they are by nature best fitted and where they can render their best service. Not a few railroad supervisors have been quick to recognize the value of vocational guidance, as it is called, and have co-operated in helping the boy to 'find himself'. While this is a comparatively new development and a new field, still its technique is now becoming fairly well understood. To a large extent this movement has been fostered on the railroads by the Younger Railroad Men's Conferences which have been held annually under the direction of the Transportation Department of the Y. M. C. A. Five such national conferences have been held, supplemented by four system conferences on the Chesapeake & Ohio, two regional conferences on the west coast, and a Canadian conference last spring.

C. Y. Thomas (K. C. S.)
Fourth vice-president

"The indications are that these will be followed by a number of system conferences, organized along the lines of those held on the Chesapeake & Ohio, if they are directed to the needs of the boys as a whole, or possibly paralleling the Santa Fe annual apprentice conferences, if they are directed solely to the needs of the boys in the mechanical department. These younger railroad men's conferences are concerned not only with helping the young man to find himself vocationally, but also in assisting him with other life problems which are related to character building.

A. H. Keyes (B. & O.)
Third vice-president.

"It is important, if the values of such conferences are to be conserved, that adequate follow-up methods be instituted and that the young men who attend also be inspired and encouraged to promote the spirit of the conference among their fellows back home.

"This need has been met in one way by the formation of the AREB, or American Railway Employed Boys' Clubs at a large number of points. Such clubs, made up of the more ambitious young men, meet frequently and promote many activities of a helpful nature. So far as the vocational side is concerned, supervisors and officers are frequently invited to address the clubs or to discuss work problems with the members. On the Chesapeake & Ohio each boy who attends a system or national conference is carefully followed up by his superiors, the president of the road himself taking a keen interest in the results, the reports of which he reviews periodically.

"Such methods are not only bringing about higher standards in the selection and training of the younger employees, but are being reflected also in the attitude of the supervisory group toward the whole question of more effective supervision.

Co-operative practices

"Another factor which has been extremely helpful in bettering human relations and improving the efficiency of the organization as a whole, has been the development in the mechanical department of employee representation, whether under labor union or non-union auspices. The eminently practical and valuable suggestions which have come from workers of all classes through this channel have done much not only to improve safety, but to remove friction points and bring about more efficient production.

"Some roads have definitely set up so-called suggestion systems. This practice in the mechanical department of one eastern road, has been extremely productive. The worker is given a bonus of 10 per cent of the savings made during the first year that his suggestion becomes effective. Naturally, the machinery for handling these suggestions must be most carefully

worked out and tactfully handled. When this is done, there seems to be no question but that it inspires a large degree of co-operation, which is extremely helpful in building up a spirit of teamwork.

"Many railroad foremen and officers have been helped greatly by attendance at the conferences on 'Human Relations in Industry' held under the direction of the Industrial Department of the Y. M. C. A. at Silver Bay, New York; Blue Ridge, N. C.; Estes Park, Colorado, etc. The contact at such conferences with workers, foremen and executives from other industries also has a broadening and helpful influence.

Broader Aspects

"So much for specific matters and concrete details. There are certain broader aspects of the task of supervision which must not be overlooked. What would it mean to the railroads of this country, for instance, if all of the employees understood clearly the place that the railroads have in our economic structure and what rapid and cheap transportation has meant to this country in bringing about political unity and in making possible our mass production processes, which have done so much to raise the standards of living?

William F. Hall
Secretary-Treasurer

"The railroads have made a very definite and vital contribution in these respects in the past and the indications are that if they keep up the present tendency toward greater efficiency and more economical operation, they will continue to mean just as much or more to the continued progress of this country in the future. It is our duty to stimulate all of the employees to study and understand these matters. No occasion should be overlooked for bringing such facts before various groups of all sorts, and they can well be given a definite place in the programs of the training groups and apprentice classes. Occasions may possibly be found when attention can be focused on them through prize essay contests.

"Is it not true that too often the mechanical department has suffered because it has been looked upon as a non-producer? What a terrible mistake to think of it in this way, and yet some of us, who are still comparatively young, can remember the time when such an opinion prevailed quite generally. We have learned, however, that the proper design and the adequate maintenance of equipment are extremely important if the railroads are to render satisfactory service at a reasonable cost. We realize, that the mechanical department, as is true of every other department, is an integral part of a great organization, every part of which has a real responsibility for helping to produce the right kind of service.

"In spite, however, of all of the plans and practices which we may set up to induce the right sort of teamwork and relationships in an organization, we are eventually faced with the fact that these are productive only to the extent to which they are promoted in the right spirit. In the last analysis, therefore, successful leadership in an organization must be regarded as a spiritual problem. The supervisor or foreman must have faith in the men working with him and a real appreciation of their possibilities and worth. Faith begets faith. Man is a peculiar being and he measures up pretty largely to your belief in him. There are, of course, exceptions to this rule, but this ought not to embitter us or prevent us from going the limit in helping to bring out the very best that there is in those who work with us."

The general foreman's contribution to long runs

By W. G. Black
Mechanical assistant to the president, Erie

An abstract of W. G. Black's address on The General Foremen's contribution to Long Runs, follows:

Long locomotive runs in freight and passenger service have become an established fact in present-day railroad practice. Almost every railroad in the country is running passenger trains 300 mi. and freight trains 200 mi. without changing engines. Some roads have gone even further than this in the length of runs. The desired results cannot be obtained by long locomotive runs alone. The locomotive must also be employed in effective service a large part of the time. This of course requires:

First: A minimum of terminal delay. *Second*: A minimum of road delay. *Third*: A minimum of shop time.

Therefore, it becomes obvious that the demands placed upon the locomotives used in long runs are very severe. Indeed, were it not for the advent of the modern locomotive—a marvel of design, power and speed—long locomotive runs would be impossible.

At the plant of the locomotive builder, the railroad company usually maintains a corps of competent inspectors who pass upon the quality of workmanship and the dependability of each integral part entering into the construction of this powerful locomotive. These men are thoroughly schooled in every detail of their work and have for their guidance elaborate specifications and blue prints which have been carefully compiled by the mechanical engineering departments of the railroad and of the builder. Each and every detailed part of the boiler is inspected both as to material and workmanship and must be pronounced O.K. by these inspectors before it is assembled. Steam and water tests must fulfill the government requirements and meet the specifications to the satisfaction of the inspectors before it is advanced to the erecting floor. In the some manner the cylinders, frames, wheels, axles, crank pins, connecting rods and in fact every detail must agree with the specifications and blue prints to the satisfaction of the inspector, before they are assembled.

When the locomotive is completed to that stage where it is ready to develop its own steam, the inspector is particular about steam leaks, proper valve setting, correct adjustment of brake work, ample clearance between moving parts, fitting of bolts, application of nuts, pipe clamps, split keys and cotter pins.

As soon as the locomotive is received by the railroad it is the duty of the railroad mechanical department to properly maintain the locomotive and keep it in service until the proper time for shopping for general repairs.

Thus the general foreman of the enginehouse to

which the new power is assigned comes into the spotlight with his duties clearly outlined. He must maintain this locomotive in such a manner that it will continue to give good service in long locomotive runs.

The general foreman at the enginehouse must become thoroughly familiar with all the details of the power under his care. As soon as new equipment is received, he must become thoroughly conversant with its operation, maintenance, possible replacements and any peculiarities of the equipment. He must educate his entire organization; inspectors, sub-foremen, gang foremen, mechanics and all others on the maintenance and peculiarities of the equipment.

It is essential that the engine inspectors in the enginehouse be absolutely competent and trustworthy with full confidence and respect for their general foreman. The sub-foremen must take a personal pride and interest in their supervision in order to obtain a high quality of workmanship and a completion of all work reported. Engine dispatchers and mechanics preparing an engine to be dispatched must be absolutely dependable and thoroughly familiar with the demands placed upon the locomotives.

Then with a good, firm, competent organization working harmoniously with him, the general foreman can be sure of continued service of the equipment under his care with a minimum of road delays and a minimum of terminal delays.

The general foreman at a terminal can also greatly assist in minimizing the shopping time of the locomotive.

The practice of shopping locomotives on a mileage basis is almost universal. About three months before time for shopping an engine, the general foreman should marshal his forces, make a complete personal inspection of the engine, and prepare a detailed statement of the repairs and replacements necessary. This statement should be furnished the back shop to enable them to order the necessary material and make proper preparation for receiving the engine. A good practice is to call together all subforemen, inspectors and engine dispatchers with road foremen, traveling engineers and traveling firemen and hold an open discussion on each engine due for shopping. In this way many points tending toward betterment of power will be brought out.

The process of repairing and rebuilding the locomotive in the railroad back shop should produce a locomotive nearly equal to the one originally turned out from the plant of the builder. I realize the railroad shop does not have the corps of inspectors, the detailed specification nor the complete set of blue prints which guided the building of the locomotive at the plant of the builder. The inspections in the back shop usually fall upon the shoulders of a few inspectors and generally receive the final approval of the supervision.

The contribution of the back shop general foreman becomes evident. He and his entire organization must be thoroughly schooled in the severe demands placed upon the locomotives used in long runs and must be prepared to complete those repairs which are the foundation of long locomotive runs. The repairs which guard against possible engine failures might be summarized as follows:

1—Turning of tires. 2—Truing up journals. 3—Truing up crank pins. 4—Fitting of all bearings. 5—Fitting of bolts—application of cotters and split keys. 6—Necessary repairs to boiler. 7—Necessary repairs to tender. 8—Attention to all accessories including air pumps, feed water pumps, stokers, injectors, lubricators, etc. 9—Checking valve gear.

If these repairs are properly completed the locomotive will leave the shop in the same general condition which it left the plant of the builder; requiring only a minimum of running repairs and maintenance at the roundhouse.

In order that the locomotives go through the shop with the least amount of delay, the general foreman must always be on the alert to speed up production without impairing the quality of workmanship. He must develop a systematic and effective schedule of the work going through the shop and he must obtain the co-operation of all departments in the shop to carry out this schedule. This is often accomplished by daily conferences with departmental heads at the close of the day's work and the maintenance of a daily progress record as an indication of the extent to which the schedules are being maintained.

The furnishing of the proper material is a very important adjunct to maximum production and first class workmanship. When improper and unsatisfactory material is received, it is the duty of the general foreman to report the facts to the proper authorities who also have a part to contribute towards long runs and efficient shop production.

All general foremen should welcome an inspection be it from his own inspector, a division inspector or one covering the entire system. He should consider their reports as his best friend because they give him first hand information of any improper or incomplete repairs made by his forces and thereby enable him to further instruct workmen who are turning out unsatisfactory work which is liable for future engine failures.

When an engine leaves the shop, the everlasting question before the general foreman should be—"What can I do to make it a better locomotive; one that will give absolutely satisfactory service on the road with a minimum of maintenance of the enginehouse?"

I feel that the mechanical engineering forces and the shop forces should work together in close unity. The mechanical engineering forces should visit the shops regularly and go over in detail the different items that are troublesome to the shop and in turn the shop forces should visit the offices of the mechanical engineer regularly for conference so that as changes are contemplated they will be applied correctly according to instructions. In this way, shop instructions, which are virtually specifications, and blue prints which originate in the office of the mechanical engineer, will be of the same value to the shop as were the specifications and blue prints which the railroad expected the builder to adhere to in construction of the new power.

It has been rightfully said that the success of a railroad is a factor of the dependability of its locomotives, and by following these suggestions, the general foreman can be sure that he is contributing his part to that dependability and to the success of long locomotive runs.

How to get greater car mileage

By E. J. Robertson

Superintendent Car Department, Soo Line

Mr. Robertson, in pointing out the manner in which the mechanical department can improve the car mileage situation, said in part as follows:

"In the first place, it is necessary that new cars be properly designed and well constructed. Experience gained from past performances will show up the weak parts of cars and advantage should be taken of this when designing and building new equipment. It is also very important to see that the actual building of

the cars is properly supervised. Practically all new cars are built by piece work and, unless the work is closely inspected at the time of building, the work is liable to be skimped, resulting in cars that will not stand up in service.

"Many cars are still equipped with spring draft gear of low capacity. Even if the spring gear is kept in first-class condition, it will not absorb the ordinary switching shocks such as we find in any transportation yard. Observation will show, however, that the spring gear does not receive the attention it should have, and cars are allowed to remain in service with draft springs that have lost their life and are much shorter than when originally applied to the cars. The draft gear is one of the vital parts of the car, and it should be kept in first-class condition at all times. This is more necessary at the present time than ever before, on account of the heavier and faster movement of trains; and the fact must not be overlooked that the wooden cars are gradually disappearing and that many trains are of all-steel construction where there are no wooden cars to help absorb the shocks; therefore, if the draft gear is not kept in first-class condition, the shocks are transmitted to the framing of the cars, resulting in extensive damage to the cars and lading.

"Periodic inspection and repairs to friction draft gear are necessary, and this inspection should be made by removing the gears from the cars, as it is impossible to determine the actual condition of the gears by ordinary inspection. By dropping the gear from the car, an opportunity is given to inspect the other draft gear attachments thoroughly, and other defects will be found that would not show up with ordinary inspection.

"Many delays and much rough handling can be eliminated by proper attention being given to the draft gear. If the gear is not functioning properly, it will cause lading on cars to shift, and it is quite often necessary to set such cars out of trains in order to have the lading adjusted.

The practice of periodically removing draft gears from cars for inspection and repairs is being followed by a number of roads, and I feel sure there is no one thing the Mechanical Department can do that will contribute more towards the elimination of delays than the periodic inspection and repairs of draft gears on freight cars and, incidentally, this will save a lot of money in car maintenance costs and claims for damaged lading.

There is quite often considerable delay and backward movement of cars on account of the cars ordered by connections for specific loading not having been properly inspected to see that they are fit for such loading before being delivered to connections. All cars ordered by connections for specific loading should be given a thorough interior and exterior inspection to insure their being fit for the specific loading for which they are wanted.

"A close observance of the A. R. A. loading rules is essential. This applies particularly to lading on open top cars. The non-observance of the Loading Rules results in many cars being set out of trains and held at interchange points to have lading adjusted or transferred and this, of course, results in less miles per car per day, besides making a dissatisfied shipper and adding to the cost of the transportation of the lading.

"There are many open top cars loaded at points where no car inspectors are located. At such points it is the duty of the agent to see that the Loading Rules are complied with. It is quite often found, however, that agents pay very little attention to the lading to see if it is properly loaded, blocked and braced, and many agents do not even have a current copy of the A. R. A. Loading Rules.

"With the lengthening of freight train runs and the fast movement of trains, it is very important that cars receive a thorough inspection at originating and inspection terminals. The transportation department, in its endeavor to move trains over the road quickly, will sometimes require inspectors to hurry their inspection, and this results in trains being delayed with hot boxes and other defects after the train has left the terminal. Sufficient time should always be given the mechanical department to inspect trains thoroughly and to put cars in condition to pass over the road.

"The matter of repairing cars in trains in transportation yards requires attention. Many defects on cars can be repaired in trains by having light repair men follow the inspectors. At small points where the expense of having light repair men in transportation yards is not warranted, the inspectors can repair many defects on cars in the trains. This practice, of course, is quite general, but some roads go into it much more extensively than others, resulting in less delays and a smaller number of cars being set out of trains on such roads.

"Many delays are caused by shippers failing to remove dunnage from cars when they unload their shipments. The tariff requires consignees to remove dunnage, such as, stakes, blocking, cleats, holddowns, etc., from cars when they unload their shipments; and their failure to do this should not be overlooked. If each case of neglect is followed up by the agent with the consignee, it will result in a greatly improved condition. In some districts such matters are brought to the shippers' attention at the Regional Advisory Board meetings, and their cooperation has been obtained with desirable results."

Mr. Dunham on car repair classifications

W. E. Dunham, superintendent car department in discussing "Passenger and freight car repair classification" said that the present methods of classifying passenger and freight car repairs are entirely inadequate and that a study should be made by the railroads in order to bring this phase of mechanical department work at least up to a stage of development equal to that of the classification of locomotive repairs. He remarked that the manner of classification for car repairs need not be essentially different from that of locomotive repair classification but that it should go far enough into detail to permit the accumulation of accurate cost figures on car maintenance. He recommended the development of a system of keeping car repair records that will enable the mechanical department officer to know the actual cost of labor and material on individual units of work.

There were five committee reports pertaining to car and locomotive subjects and the abstracts of some of these follow while other will appear in subsequent issues of the *Railway Mechanical Engineer.*

The elimination of federal defects

In looking at this question of elimination of federal defects, there are two sides that must be treated. One is the elimination of minor defects *before* unlawful defects develop and the other is the elimination of un-

lawful federal and other defects *after* they develop.

The first method should be discussed first because elimination of federal defects means that they shall not occur.

The only way to do this is to have inspections made frequently enough so each and every minor defect will be repaired before it reaches the "pink slip zone."

To do this will require inspectors for the railways just as fully trained, just as alert and just as keen to diagnose things they may see, as any federal inspector may be.

Some of us have got a long way to go before we reach this goal. On the other hand we have some men just as good as are employed as federal inspectors.

We are of the opinion that if the workmen involved in keeping up the repairs on our locomotives, were all thoroughly familiar with what is required in the line of repairs and upkeep, that better co-operation of all concerned would be attained. Consequently, a smaller number of defective engines would be reported by our federal inspectors. In order to accomplish this result we recommend that every supervisor, mechanic, apprentice, inspector, engineer, fireman, dispatcher, chief dispatcher, trainmaster, traveling engineer, or road foreman of engines, as well as the supervisors directly concerned, should be furnished with a copy of the book of rules governing the testing, repairing, and operation of all locomotives and tenders. They should also be familiar with these rules so that repairs can be made quickly; thus reducing, to a minimum, the loss of time that the locomotive is out of service.

Standard practices should be established and maintained.

Eliminating defects after they have developed

Getting on down to the elimination of federal defects in the other sense; that is, after they have become so.

There are parts that can be increased in strength or size. As long as our locomotives continue to be built along their present lines, I think that we might adopt a slogan and live up to it, such as: *"Increase the size"* or *"increase the wearing surface."*

It often happens that definite instructions are not given by the supervisor directly in charge, consequently the workman is not thoroughly familiar as to what results he is expected to produce. When general letters of instruction are issued, a sufficient number of copies should be furnished so that each workman having to do with the particular class of repairs, could be furnished a copy and by so doing he will know exactly what is required and expected.

Sufficient amounts of repair parts and material should be readily accessible for prompt and permanent repairs when defects are found and reported.

General repairs or back shop work should be thoroughly done and not depend upon the roundhouse to carry the burden of the repairs, after the engine is put into service.

Get as many miles out of your locomotives as possible by close observation of each and every part, repairing such parts *before* they reach the limit, and not after.

Well lighted enginehouses and inspection sheds with pits for underneath inspection as well as exterior, promote better inspection. Enginemen are handicapped as a rule by having to inspect after dark with only a hand torch.

Clean engines are encouraging to the engine inspector. They give him a better opportunity to detect any defect that might exist. We believe in complimenting and encouraging an inspector as well as disciplining him.

If an inspector reports a defect that is difficult to see, we should let him know that we appreciate his work; and on the other hand, if he neglects his duty and fails to report defects that he should see, then discipline should be administered.

Engine crews can prevent federal defects by making intelligent work reports. This has reference to all work they report to know that the work that they are reporting are defects and not guess-work on their part.

To eliminate federal defects it requires education, that is, the practical education of the shopmen to observe the condition of the parts that are working on, as well as other parts of the engine.

Machinists while working underneath an engine should make an inspection of brake rigging, inside of frames, driving spring equalizers and spring hangers for cracks or any other defects that might exist underneath a locomotive. A machinist while working on rods should observe all rods to see if bushings or brasses are worn to the limit or have excessive lateral, flaws or cracks in straps or rods.

Cab men should take care of all leaks and defective fittings in the cab. If there is steam pressure on the boiler he should open the drain valve to water glass, allow water to drain out, then close valve to see if water comes to full height in less than five seconds. He should also try throttle lever latch and reverse lever latch to see if they hold, and make inspection of gauge cocks to see if they are open.

Boilermakers when making hammer tests on air reservoirs should hammer them with the intention of finding defects if any exist, and not merely hammer for the purpose of making hammer marks for the Federal Inspector to see.

Modern washout plugs have practically eliminated the washout plug defect. The solid brass plug formerly used, after removing and replacing several times, became defective on account of leaking or being cross-threaded by the boilerwasher. These defects will show up after the locomotive is hot and ready for service.

Using high speed safety motors on staybolts burn the threads in the sheet and will leak after the locomotive is in service a short time, not only making the locomotive defective, but is very expensive to the company to take it out of service and renew the staybolts.

Floating bushings applied to main rods and middle connections will reduce federal defects to a great extent.

Foundation brake rigging should be properly designed, applied, and adjusted, after which, if properly and frequently inspected, will avoid federal defects.

Cylinder cocks of a proper design sufficient to release the water from cylinders will do as much as any one thing to reduce federal defects and prolong the life of a locomotive.

Tank trucks should be built with as much care and pains as engine trucks. If trucks are not squared properly it will cause sharp flanges.

Foot board hangers should be of proper material and sizes, and toe and bottom boards should be of first class material and proper sizes and correctly applied; rigidly inspected daily to avoid federal defects.

Running boards, hand rails, cab grab irons, tank hand holds, and sill grab irons, sill steps, tank steps and pilots should be properly and permanently fastened and daily inspections made for cracks or breaks in the bends of iron, where possible fractures may appear. By doing so, federal defects are reduced.

Couplers, draw bars and safety bars or chains, as well as all pins should have a daily thorough inspection and coupler or draw bar castings should have the same close inspection to avoid federal defects.

Thorough inspection, complete repairs, and a recheck

or inspection and testing before the locomotive is listed for a run, will produce better results than to list the engine and then hurry the repairs.

Workmen should be properly supervised when repairs are being made, and on the other hand there should be sufficient number of supervisors to properly oversee and to know that the work has been done correctly.

Eternal vigilance, daily inspections, prompt and permanent repairs, and close co-operation by all concerned, is the only cure for defective locomotives.

The report was signed by C. E. Horsley, (Illinois Central) and O. J. Beavers, (Atlanta, Birmingham & Coast).

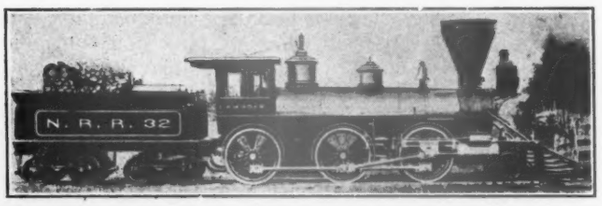
Discussion

During the discussion of this topic a member who has had 18 years' experience as an enginehouse foreman and is now a shop superintendent made the remark that the enginehouse foreman must bear the brunt of the criticism that is made when locomotives are found in poor condition and that in the majority of instances it is not his fault at all but rather the fault of the back shop which has neglected to do a good job on the locomotive when it was given general repairs. He stated that while still an enginehouse foreman, he had been able to remedy conditions by inspecting the locomotives personally and then bringing any defects found to the attention of the back shop supervisors at their daily meetings. Speaking of the manner in which to get the most out of inspectors this same speaker said that foremen should make sure to give inspectors credit for doing unusual work and that a record should be kept of such creditable performances so that when it is necessary to administer discipline it may be done with a full knowledge of what allowances to make for the good work a man has done in the past.

Other speakers pointed out that in order to eliminate federal defects it is important that supervisors, mechanics and even apprentices know what such a defect consists of. The consensus of opinion seemed to indicate that general foremen, shop foremen, enginehouse foremen and inspectors should be provided with copies of the I. C. C. rule book and that they should be compelled to take periodic examinations on the rules. A question was asked by the chairman as to how many of the roads represented supplied rule books to mechanics and the replies indicated that only about 10 per cent followed such a practice although some roads supply their men with the books upon request.

It was brought out that some roads are now regularly examining the supervisors concerned with locomotive maintenance and operation on the I. C. C. rules. On one road the general foremen, shop and enginehouse foremen and inspectors take examinations annually on about 300 questions relating to the rules and a passing average of 75 per cent is required. These men are then fitted to instruct those under them.

* * *



A 2-6-0 type "A. M. Shaw" on the Northern Railroad of New Hampshire

A handy bulldozer for removing bulges

By Jos. C. Coyle

IN putting several hundred steel coal cars through a repair shop, it was found necessary to devise some quick and efficient method of straightening the car ends, nearly all of which were bulged outward. Hence, the improvised bulldozer shown in the illustration. Two 8-ft. lengths of 7½-in. by 5-in. crane rails were joined together near one end by two 3¼-in. by 6-in. angle irons, secured at each corner by four 1-in. by 9-in. bolts. Against these cross braces, which

A portable bulldozer for removing bulges from freight car ends

are 16 in. apart, was bolted a 16-in. by 16-in. air cylinder, reinforced at the back by a 1½-in. steel plate and by a ½-in. by 2-in. strap along each side. A push bar, 5 ft. in length, made of 5-in. by 7-in. steel rail and reinforced by 1-in. steel straps riveted in the channels, was bolted crosswise to the end of the cylinder piston. This fits against the bulge which is to be pressed in. Two 5-ft. lengths of 1¼-in. by 10-in. steel bar, bolted at right angles to the two main vertical beams, have deep notches cut near the ends to hook over the corners of a car while the machine is in operation. The bottom end of the main beams are held in place by two large chains secured in the lower corners of the car.

The machine is moved from car to car and held suspended in place by one or two 15-ton overhead cranes. A shop air pressure of from 120 lb. to 140 lb. is used for this work.

Car supervisors meet in St. Louis

Two associations of car department officers unite—Present instructive joint convention program

WITH a total combined registration of 695, including 368 railroad members and guests, the Railway Car Department Officers' Association and the Southwest Master Car Builders' and Supervisors' Association held a joint convention at the Hotel Statler, St. Louis, Mo., September 11 to 13, inclusive, at which numerous instructive addresses and committee reports were presented in a well-balanced program. By far the most important and constructive work of the joint convention, however, was its lively debate and final ratification of previous executive committee action looking towards the merger of the two associations. The plan for merging or consolidating the associations was almost unanimously approved in the interests of economy and the formation of a strong, united body of car department supervisors which can better serve the interests of the railways as a whole and of the individual association members.

The name selected for the new association was the "Master Car Builders' and Supervisors' Association," the membership to comprise railway master car builders and all car department men employed in a supervisory capacity. The object is to promote more efficient maintenance and use of cars, by the discussion of interchange rules and all branches of car department work not now given detailed consideration by the Mechanical Division of the American Railway Association.

Election of officers

The following were elected officers of the new association: President, S. O. Taylor, master car builder, M.P., St. Louis, Mo.; first vice-president, C. J. Wymer, superintendent of the car department, C. & E. I., Danville, Ill.; second vice-president, K. F. Nystrom, superintendent of the car department, C. M., St. P. & P., Milwaukee, Wis.; third vice-president, F. A. Starr, supervisor of reclamation, C. & O., Richmond, Va.; fourth vice-president, L. R. Christy, master car builder, Gulf Coast Lines, I. G. N., Houston, Tex.; secretary-treasurer, A. S. Sternberg, master car builder, Belt Railway of Chicago, Chicago.

The board of directors consists of Chairman G. W. Moore, assistant superintendent of motive power, Frisco, Springfield, Mo.; (two-year term) P. Kass, superintendent of the car department, Rock Island, Chicago; C. J. Nelson, chief interchange inspector, Chicago Car Interchange Bureau, Chicago; O. H. Clark, supervisor of car repair bills, I. G. N., Houston, Tex.; W. J. McClellan, special inspector, N. Y. C., New York; C. A. McBurney, master car builder, Transcontinental Oil Co., Tulsa, Okla.; (one-year term) A. Armstrong, chief interchange inspector, All Lines, Atlanta, Ga.; C. M. Hitch, district master car builder, B. & O., Cincinnati, Ohio, and E. J. Robertson, superintendent car department, Soo Line, Minneapolis, Minn.

Features of the program

The convention was divided into six business sessions, three morning sessions being presided over by G. W. Moore, president of the Southwest Master Car Builders' and Supervisors' Association, and the afternoon sessions presided over by E. R. Campbell, president of the Railway Car Department Officers' Association. In his opening address on the morning of September 11, President Moore outlined the objects and advantages of consolidating the two associations and mentioned the following car department problems, toward the solution of which a great deal has been accomplished during the past few years, but which still need the attention and study of car department officers: Proper care of journals to avoid hot boxes; maintenance of air brakes; proper inspection of cars at loading and terminal points to avoid subsequent troubles, such as damage to commodities, transferring loads or accidents due to defective equipment.

Speaking for L. W. Baldwin, president of the Missouri Pacific, E. H. McReynolds, assistant to the president, formally welcomed the convention to St. Louis. Mr. McReynolds said that there is too great a tendency for railroad men to confine their efforts and attention solely to their respective departments, losing sight of the fact that only through close co-operation can the best results be secured. He made a special plea for car department officers to help their respective publicity departments by furnishing information regarding unusually good operation, needed in properly informing the public regarding the progress and accomplishments of the railroad. He said that the time is here when railroad officers must inspire all employees to "sell" their respective roads to the public in order to meet the present crisis caused by motor, air and water competition.

Henry Miller, president of the Terminal Railroad Association of St. Louis, then addressed the convention and was followed by R. C. White, assistant general manager of the Missouri Pacific, and R. H. Innes, inspector, Bureau of Explosives, Dallas, Tex. Other individual papers presented at the convention included Higher Maintenance of Freight Car Equipment to Reduce Terminal and Transit Delays, by L. R. Wink, assistant superintendent car department, C. & N. W., Chicago; Freight Claim Prevention in Relation to Maintenance of Freight Car Equipment, by J. Marshall, special representative, A. R. A., Chicago; The Elimination of Angle Cocks from Passenger Car Equipment, by J. P. Stewart, general supervisor of air brakes, M. P., St. Louis; Efficiency of Car Shop Operation, by B. J. Huff, efficiency supervisor, C. & E. I., Danville, Ill.; Testing of Car Materials, by J. R. Jackson, engineer of tests, M. P., St. Louis, and The Inspector, by A. Armstrong, chief interchange inspector, All Lines, Atlanta, Ga. The report of the Question Box Committee, J. Matthes, Jr., traveling car inspector, Wabash, Decatur, Ill., chairman, was read and discussed, also the joint report of the A. R. A. Committee, H. A. Sigwart, supervisor car repair bills, M. P., chairman. Abstracts of these addresses and committee reports will appear in this and also in subsequent issues of the *Railway Mechanical Engineer*.

Address by Henry Miller

Since freight cars particularly are now practically used universally, it is of the utmost importance that every effort be made to expedite the movement of traffic by simplifying the rules in every possible way.

Certainly, no rules which tend to slow up repairs or interchange should be considered, and nothing should be left undone to facilitate car movements safely.

When you take into account that the average mileage of freight cars is about thirty miles per day, and that this is the common speed per hour of a freight train, you will realize that the problem of making greater mileage is the paramount consideration.

None of you would consider employing labor or machinery that only rendered one hour's service in the twenty-four, and it is my suggestion that you take this fact home and do your part to improve car mileage.

The division of car service of the American Railway Association has an effective organization, which has greatly improved the distribution and use of freight cars, a distinct advance in car efficiency; however, many local associations have made rules dealing with local conditions. These are essential but often obstructive.

Cars are often set back by too technical inspection; in fact, instances have come to light where the inspectors of connecting lines, contending with each other, go out of their way to find reasons for rejecting rather than for passing cars in reprisal for similar activities, unnecessarily delaying both the cars and their lading. Such delays are costly to both the railroad and patron; hence, your slogan should be to keep cars moving in their authorized direction, avoiding setbacks.

To this end, one of the best rules in the category, to my mind, is the requirement that a receiving line shall run, repair or transfer all loaded cars, thus eliminating the lost motion of setbacks, the bane of every large terminal.

Railroads get their 'bread and butter' from freight revenue. Their investment in freight cars is enormous, and has been increased within the past six years by the addition of 800,000 cars costing $1,500,000,000; therefore, I repeat that your membership should exert their influence in every way that will tend to increase car efficiency.

Standardization of freight cars important

The American Railway Association has had under consideration for many years and some progress has been made in the standardization of freight cars. There is no more important problem for your membership to study and give constant attention to than the standardization of freight cars, particularly those parts that require frequent repairs and renewals.

Examination in a large car repair plant revealed the fact that on cars of the same capacity parts such as trucks, bolsters, center plates, arch bars, draft gear, bolts and many other parts that wear and become defective, were of different size and standard in amazing numbers; therefore, apart from your own material requirements, it becomes necessary to carry a large stock of different parts for the many different "foreign" sizes and standards. Their investment is considerable, and cars are frequently held until the material is shipped long distances. All of these things work against efficiency of car movements and mileage, and tend to increase the cost of maintaining the equipment.

This phase of the car business assumes enormous proportions in large terminals such as we have in St. Louis, where the turnover annually is about 2,500,000 freight cars, the equivalent of every freight car in the United States. Here, the daily complications arising from the use of many different standards by the railways are a constant and continuous problem, greatly emphasizing the necessity for simplifying the rules and standardizing the equipment in order to get the best results in the use of freight cars.

E. R. Campbell (Minn. Transfer) President — **M. E. Fitzgerald (C. & E. I.) First vice-president** — **F. A. Starr (C. & O.) Second vice-president** — **A. S. Sternberg (Belt Ry. Chicago) Secretary**

Officers of the Railway Car Department Association

We recently built a number of locomotive tenders, the under-frame a steel casting with the bottom or floor cast integral, and the side and end sheets of the cistern welded to it; all joints, braces and attachments welded —no bolts or rivets—thus creating one piece construction above the trucks. Weight about 60,000 lb., capacity 110,000 lb.

Also a one-piece frame for locomotives, reducing and simplifying the number of parts immeasurably, both designed to increase durability and decrease maintenance.

Perhaps this type of construction might be applied to freight cars and prove more substantial and simple than the present method. Since locomotive tenders and frames are subjected to more constant and severe service than freight cars, here is an opportunity for you to exercise your ingenuity in the improvement of car design and construction.

Another essential feature of the car business is

caused by the almost universal use of freight cars, which sends them all over the United States and Canada, with the result that cars are frequently away from home a year or more, and the practice of simply giving them a lick and a promise to enable the disposition of cars, from one road to another, results in under maintenance, so it is of the utmost importance that freight cars be well maintained in order that they may produce maximum mileage and revenue.

Common repair shops suggested

I have always thought that it might be well to consider having common repair shops at large concentration points; by that I mean large railroad centers like New York, Chicago, St. Louis, Pittsburgh, Buffalo, Cincinnati, Kansas City and other similar centers that produce and receive large amounts of traffic, where large numbers of cars naturally accumulate, should have repair plants of common or community ownership sufficiently large to make all repairs, and if necessary a general overhauling of freight cars. Railroads may have ample capacity at their own shops to do their own work, but the problem of getting the cars to these shops is one of great moment.

Moreover, at these large railroad centers cars are more frequently damaged, and very few of the railroads have large car repair plants at these large centers, which necessitates hauling cars that are damaged, the repair of which requires their going to a general shop, involving long hauls of disabled equipment empty and a loss of time that in many instances runs into months before they finally reach repair shops and are repaired and resume service; hence, it seems to me that it would pay the railroads of the country to consider the establishment of large repair plants of common ownership at places where cars could be repaired most conveniently and economically, or adopt some equally effective plan to reduce bad order cars to the minimum and improve the standard of maintenance, the necessity for which you all recognize. The latest bad order report, 6.7 per cent, tells its own story. If kept below 4 per cent there would be available for use about 70,000 more cars, the earnings of which would go a long way toward paying the interest on the suggested plan.

G. W. Moore (Frisco)
President

J. H. Hayden (M.-K.-T.)
First vice-president

P. H. Mitchell (T. & P.)
Second vice-president

H. A. Sigwart (Mo. Pac.)
Third vice-president

E. H. Weigman (K. C. S.)
Secretary-Treasurer

Officers of the Southwest Master Car Builders and Supervisors' Association

Handling dangerous articles

R. H. Innes
Inspector, Bureau of Explosives, Dallas, Texas

A tank car, with casinghead spraying out of the safety valves, went to an interchange track and a car inspector was called to stop it. He arrived on the ground with a lantern, but, knowing that gasoline vapor and lights "raised Cain" when they meet, hid the light behind a scale box, 75 ft. from the tank car. The wind was blowing from the east; the scale box was west of the tank car. He thought that by loosening the dome cover he would be able to reduce the pressure; he turned it, but it was still tight; he turned a little more and still no gas came. He overlooked the fact that the pressure was jamming the threads together. He kept turning slowly until the cover was sure enough loose; in fact it was off, and the gasoline was shooting, I expect, 10 ft. into the air above the dome. Jumping off into the vapor, he started for the lantern but the vapor beat him, becoming ignited, when he was about 35 ft. from the tank car, and he fell to the ground enveloped in flames, his clothes saturated with vapor, possibly wet with gasoline. A switchman who was standing at the end of the tank car out of the vapor, rushed over and rolled him on the ground, extinguishing the flames and saving his life. He had a few scars on his ears as a memento.

Another tank car of casinghead had been in a wreck, was picked up and brought to the rip track. It had not leaked but was in bad shape otherwise; the car was going to a connection and to comply with the re-

quirements of the claim department, they requested the tank car gaged (a fool thing to do), calling on the car foreman, who is generally called on when there is any trouble. He had heard me talk to the Car Men's Association at Ft. Worth and knew he had to get rid of the pressure before taking off the cover, so he raised the valves. As it was an extra job and regular work was suffering and it sometimes takes nearly an hour to get rid of the pressure, he thought he would let a little off by loosening the cover. As in the former instance the pressure kept the cover tight and if he had jumped on the cover would have found it loose. He kept loosening it more until it was off, the gasoline shooting up into the air, vaporized, and the vapor blown by the wind got to the fire under the boiler in the shop, flashing back and setting several cars on fire. The carmen got away out of the vapor. A boilermaker, around the corner of the roundhouse, was the only person burned, and he only slightly.

I do not know the particular class of dangerous articles you are all interested in but I do know that gasoline and casinghead is moving from Texas to all parts of the country and so am going to discuss tank cars bearing inflammable placards, consequently containing inflammable liquids, or those that, when heated to a temperature of 80 deg. F., give off a vapor gas that will burn. Gasoline does this below zero.

I am not going to talk about dynamite, powder, etc., because we have about made a success of handling them. In 1907 we killed 52 people on the railways of this country, half the number next year, six in 1909, less and less every year until years would pass without a fatal accident. For the last three years there have been no accidents with dynamite; last year, three little ones with fireworks (nobody hurt), and the loss to the railways of this country and Canada was only $45.

What is vapor tension?

There are so many grades of gasoline that it is hard for anyone, other than an expert, to tell exactly what kind is being handled. Also, it is affected by the temperature and the barometer to a limited extent. Gasoline may have a vapor tension of 2 lb. or it may be 10 lb. Please remember that I am discussing gasoline, not casinghead.

Perhaps some of you do not understand what is meant by vapor tension. We take a brass cylinder holding about 500 cu. cm. (nearly 1½ pints), fill it, then take out 10 percent to leave space for the vapor to collect, and place on it a pressure gage. We then submerge it in water at a temperature of 70 deg., F., keep it there until the gasoline has had time to heat through, then remove the gage carefully, a little at a time, or the gasoline will boil out. When the pressure is all off, we tighten the gage and place the cylinder in water at a temperature of 100 deg. in the summer or 90 deg. in winter. The pressure shown on the gage is what is known as the vapor tension. Commercial gasoline, the kind we use, is seldom over 3½ lb., but the same name applies if the vapor tension is 10 lb. So the fact that the waybill reads gasoline does not mean that it is the gasoline used for motor fuel. It may be of 10 lb. tension and almost as bad as casinghead of 10.1 lb., as gasoline must be called if it develops 10 to 20 lb. vapor tension, which must be shipped in insulated tank cars, Class IV.

Now we may know what it is, but nobody knows what the vapor will do. I will cite you a few instances that came under my observation. There was a wreck of several tanks of gasoline and casinghead at the upper end of a light cut, none of the gasoline escaping into the ditch in the cut but going into a low place above the cut. It was a still night, and the vapor, filling the low places, finally reached the ditch in the cut. Then, being on a grade, it ran down the ditch about 180 ft. When the engine with the derrick car reached the lower end of cut, there was a flash up the ditch, igniting the vapor in the wreck and burning up $119,000 worth of property. Fortunately the crew was with the derrick outfit. On the next day I found the grass in the cut burned up to a height of about one foot. Above that it was perfectly green. The derrick car had passed over the vapor without igniting it, being three cars ahead of the engine and having a fire high above the vapor.

[Mr. Innes here cited several additional instances of fire and loss due to the mishandling of wrecks.—EDITOR]

The proper place for dome covers

Now a few words about dome covers. The proper place for a dome cover is screwed down tight on the tank car, but sometimes you have to take it off. Do you know that St. Louis, Ardmore, Atlanta, St. Paul and Memphis accidents were all caused by taking off dome covers on loaded tank cars, without getting rid of the pressure by raising the safety valves? Liquids vaporize, they also boil, casinghead gasoline, at about 60 deg. F.; water, at 212 deg. F., under atmospheric pressure. Take a bottle of casinghead and grasp it in your hand and it will boil, but when it boils, pressure builds up until it ceases to boil. So you see there are two conditions which have to be considered: the temperature and the pressure. In a steam boiler carrying 200 pounds pressure, the water has to be heated to 375 deg. to keep that pressure up.

Now in the tank car of casinghead with a boiling point of 60 deg. at atmospheric pressure, when the temperature is raised to 75 deg., pressure builds up, say to 15 lb., and remains there while the temperature remains the same. What takes place? Nothing, so long as the temperature and the pressure remain the same, but you have a tank car full of a liquid which will boil if the heat is increased or the pressure lessened. You take off the dome cover and immediately the liquid, being all of 15 deg. above the boiling point, begins to boil all over and boils out of the dome. Now when you raise the safety valves, the pressure being reduced slowly, the gasoline begins to boil slowly and continues to boil until the rapid evaporation reduces the temperature down to 60 deg., the boiling point at atmospheric pressure. Then take off the dome cover slowly removing gradually when off, because there might be, if in summer, a rush of hot air into the dome, air perhaps at 100 deg. With gasoline simmering at 60 deg., the hot air would raise the temperature and if it does, the gasoline boils over.

Transferring tank cars

In transferring tank cars, the best way, if you have a good sized pump (2½-in. at least), is to connect the suction and the discharge to the bottom outlet pipe. Don't forget that your pump should be operated by air if you have not a steam line through your outfit. Air works well.

Most of our derricks are equipped with the false dome cover designed several years ago by Inspector Scott, of Kansas City. Some of our foremen have made false dome covers out of two thicknesses of one-in. lumber crossed, with two 2½-in. nipples through them, and a strong wood crosshead. If the tank is

leaking badly, air pressure will increase the leak, but water will do just as well. By reducing one of the nipples to fit the air fixtures, the transfer can be made by air, if there are no bad leaks. One of our foremen has an attachment that fits on top of a safety valve so that it can be raised and air forced into the tank. If you can use the bottom outlet for a discharge, this is a fine way as the dome cover is not touched. I dislike to see dome covers off of any tank car.

I am partial to the use of water in transferring, as the mixing of air and vapor in certain proportions is a dangerous mixture, but water doesn't mix with vapor. Some months ago I had an insulated tank, Class IV, badly damaged; the bottom outlet was knocked off as usual, the valve unseated and the tank leaking over both transoms; in fact it was dropping gasoline from one end of the tank to the other. It was fortunately located at a point where we could use the water service of a creosoting plant. Not having any false dome covers, the safety valves were removed and connections made to the flanges, one for water and the other for discharge. On the discharge we had a pet cock so we could, by letting the liquid drop out into a bottle, ascertain whether gasoline or water was coming. We did not leave any gasoline whatever in the damaged tank and did not have as much as an inch of water in the good car, this being easily drained out at the bottom.

The empty tank car

It would seem unnecessary to talk about the empty tank car but now and then some poor fellow with fire is blown out of, or off, an empty tank car. Sometimes he remains in there and cooks slowly. Now, if the dome cover is on tight, a trespasser is not likely to get in the tank to steal a ride or, as in one instance, to transport "booze." But if a tank car has to be worked on, of course the dome cover may have to come off. As to what the tank last contained, or how long ago it was loaded, it doesn't make any difference. Lots of men have been blown from water cars. A man who gets into an empty tank car, without knowing positively that there is no vapor in it, must want to commit suicide.

About eight years ago no two manufacturers of casinghead gasoline adopted the same methods, so far as pressures and temperatures were concerned, but now we are getting as safe a product as possible. The railways are indebted to the larger and some of the smaller gasoline companies for the care taken by them in the preparation of their tank cars as required by I. C. C. regulation No. 401; and, by the way read No. 402, it is also a good rule.

Now a few words about the dangers of gasoline-loaded tank cars bursting. There is nothing in a tank car of gasoline that will burn in the car; the only difference between the dangers of such a tank car and one filled with water is that it takes less heat to make it boil. But if both are equipped with 25-lb. safety valves and the shell tested to 60 lb., the danger is the same in both; but if the tank does give way, in one case you have the air filled with a vapor more dangerous than dynamite and in the other steam.

A tank of gasoline with fire around it will only burst when the safety valves do not operate. If a tank-car of either water or gasoline is surrounded by fire and it is playing on a part of the tank where there is no liquid, the metal will get so soft that it won't stand the 25 lb. pressure the safety valves are holding and it will give way. But if the fire is hot enough to melt iron, you can't do much good, so keep away. If, however, there is a little fire from a leaking bottom cap or up around the safety valves on the dome, a few wet gunny sacks or a few shovels of sand will put it out.

My closing suggestions are: Keep dome covers on; keep yourself and men out of the vapor when not actually having to work in it. You may have to take chances to get the line cleared and it may pay to burn up several thousand dollars worth of the company property, but you must not burn up folks. Remember the warning on the placard: "Keep Lights and Fires Away."

Car maintenance to reduce terminal and transit delays

By L. R. Wink

Assistant superintendent of the car department, Chicago & North Western, Chicago

If railroads were given the same opportunity in operation that other large industrial concerns enjoy, this paper would not be necessary, as freight-car equipment could be thoroughly maintained, but when we stop to consider the restrictions that are placed on the railroads in connection with passenger and freight rates, and wages paid to employees, together with heavy taxes, one can readily appreciate that we are compelled to maintain our equipment at an extremely low cost, and devise every means and scheme possible to accomplish the result of providing suitable equipment at a limited expense.

We are fully aware of the handicaps and hardships imposed upon us by excessive governmental regulations, inadequate rates, unequal and burdensome taxation, and the like, and all loyal employes will study the subject and communicate the facts regarding conditions on railroads to the general public in ordinary conversation, in giving information to children for debates in high schools and colleges, and in every other possible way. In this manner we can help to acquaint the layman, who is slow to learn when not directly concerned, of the difficulties the railroads are contending with in performing the service required of them properly and with reasonable profit.

There is a greater tendency on the part of shippers and others to assist and co-operate with railroads generally, than there was in the past, and by keeping the matter before the public in the right light, much can be accomplished, and I believe the railroads will eventually come into their own.

Approximately 20 per cent of railway gross earnings is expended for maintenance of equipment, a large percentage of which is required in the maintenance of locomotives. Another big share is taken for the maintenance of passenger cars to meet the present day requirements of an exacting public. Passenger trains are often operated at an actual loss, passenger revenue being depleted on account of automobile, bus and now air plane competition. The result is, that there is not a large or equal proportion of the gross earnings left to maintain properly and thoroughly the freight-carrying equipment to meet the present heavy tonnage train requirements, notwithstanding the fact that freight traffic produces the greatest source of revenue.

Maintenance of freight cars on repair tracks

The backbone of freight car maintenance is the work performed on shop and repair tracks and, therefore, too

much attention cannot be given to its systematic and efficient organization and the operation.

Various plans are followed today in the rebuilding and general repairing of system freight cars by segregating cars by classes. Under such programs, the modern all-steel freight cars are receiving extensive repairs, and in many cases, are being rebuilt with betterments added.

This equipment, after being released from the repair tracks, should be in condition to transport high class commodities, barring accident or wreck, and remain in serviceable condition for a number of years without further attention, except, of course, the ordinary running repairs.

The lighter class of repairs to freight equipment is equally as important and under no circumstances should this class of car be permitted to leave the repair tracks unless it is in proper condition to carry its load to destination.

Special attention should be given to the periodic repacking of journal boxes, which should be properly performed by the jacking up of the journal boxes, inspecting journals and replacing defective brasses, wedges, repacking journal boxes with waste, properly saturated with a good grade of oil, to avoid delays on account of hot boxes.

Likewise, the trucks, draft gears and brake rigging should be thoroughly inspected, tightened, adjusted, defective parts removed, and necessary attention given to cleaning and testing of air brakes.

It follows that in order to obtain the maximum efficiency of a repair track organization, a competent and efficient staff of supervisors is necessary. Often we are handicapped by payroll restrictions, and, therefore, these expenditures must be made in the most advantageous manner.

Inspection of cars at yards, freight houses, industries, etc.

In reducing terminal and transit delays, the proper inspection of freight cars in terminal yards, freight houses, industries, etc., is one of the most important factors. Entirely too many failures and delays are due to improper inspection and attention at originating terminals. All of these delays cannot be rightfully charged to the car inspector for the reason that frequently sufficient time is not allowed him to permit thorough inspection of the cars. It is, therefore, important that the operating department co-operate with the car department in this matter and allow as much time as possible to do the work, with a reasonably adequate force of inspectors.

With the continued increasing speed of trains and the demands of the shipping public for better service, there never was a time in the history of railroads when the car inspector was such an important factor in reducing terminal and transit delays. He must be properly educated as to the handling of his work, with a thorough knowledge of A. R. A. interchange and loading rules, safety appliance rules, and other I. C. C. requirements.

Closer relationship between supervisors and inspectors is essential, keeping in mind a means of constant education. On the Chicago & North Western car inspectors are constantly checked as to their understanding of these rules, and other railroads are, no doubt, following along similar lines.

There is only one benefit, as I see it, to be derived from a delay or failure due to car defects and that is, to determine its cause and use the delay or failure as an object lesson to all concerned with a view of preventing a similar or more serious accident or delay in the future. This can only be accomplished by a thorough and intelligent investigation of all failures by supervisors, actual conditions being reported as they are found to exist.

The inspection of cars for special loading requires unusually good judgment on the part of car inspectors to avoid claims, transfers and delays. Too often inspectors' opinions differ as to the suitability of equipment for various commodities, and on this account, serious consideration must be given to the education of all inspectors with a view of securing uniform understanding.

Inspection of freight train cars at out-going freight houses

Another feature is the proper inspection and repairs to cars at out-going freight houses where there is often good opportunity to make thorough inspection and light repairs, testing brakes and repacking journal boxes. We are getting exceptionally good results along these lines at Chicago & North Western freight houses, particularly at our new Proviso yards. It may interest you to know that the Chicago & North Western has under construction at Proviso, thirteen miles west of Chicago, a freight terminal, including a transfer freight house and three fully equipped repair yards, which, when entirely completed, will involve an expenditure of approximately $16,000,000. The immensity of these improvements can perhaps be better understood when I state that the total area covered involves 1,250 acres, providing for a track capacity for 26,000 cars. The transfer freight house, which has been completed and is in operation, has an area of space under cover of 21 acres, and provides for a daily capacity of 700 cars of merchandise.

Appreciating the importance of giving cars loaded at this freight house the best attention possible, to the end of avoiding terminal delay and delay enroute, proper and adequate facilities were provided. For the testing, cleaning and adjusting of air brakes, all tracks are piped, and in a manner providing for individual car tests.

Housing material for light repairs

For the housing of material necessary for light repairs, a modern cement building is in use as a central source of supply. Sub-stations are distributed at convenient locations throughout the freight house, material being furnished to load them by gasoline operated tractors. For the manufacture of journal-box packing, a cement building housing modern packing renovating equipment is in use.

In the matter of avoiding unnecessary delays and transfers, great assistance has been derived from interchange bureaus. We all know that our greatest problem is getting cars through the larger terminals without delay, and I have been firmly convinced that nothing more effective can be devised to remedy this than a well organized interchange bureau. Such an organizaton, in order to obtain the best results, must be comprised of exceptionally well trained and reliable employees, and it is especially essential to have it supervised by able and energetic men who are thoroughly familiar with all the phases of car department and operating details.

What can be accomplished by a neutral organization of this character has been well demonstrated in Chicago during the past three years, and I am sure that every car department official who is familiar with

the details will approve of my referring to this as a shining example of what can be achieved by intelligent and efficient men who are willing to devote their best efforts.

While the many irregularities corrected are too numerous to dwell upon on this occasion, it is interesting to know that 11,000 cars were transferred in the Chicago territory during the year 1924, which was reduced to approximately 1,500 in the year 1927, that the A. R. A. loading rules are being complied with and that both loaded and empty cars are moving through the Chicago terminal more expeditiously than ever before; but the most gratifying accomplishment is the splendid relations that exist between the shippers and the carriers. I have no doubt but that similar efficient results have been accomplished at other large terminals, but the fact remains, that too many cars are still being transferred, that too many cars are still being improperly loaded, and that there is still too much cross-hauling of empty equipment throughout this country. There is no question in my mind but that these conditions can be greatly improved by the use of good judgment and proper co-operation, without increasing the maintenance cost in the slightest degree.

Intelligent retirement of old and obsolete equipment

A large percentage of delays in transit is due to obsolete cars of small capacity. Keeping up the general condition of equipment depends largely on the new equipment which can be injected in replacements year by year, which is governed by financial conditions.

With the present costs of new equipment, and the present financial situation, the subject of retirements of old equipment in place of repairing and re-conditioning is one requiring thorough study and consideration.

It is poor policy to expend $400, for example, in repairs to an old car which, inside of a few months, will again be on the repair track requiring another large expenditure to continue it in service. When old equipment is reconditioned, the reinforcements and betterments should be of such a character that a reasonable expectancy of future life can be assured, even though the cost is rather high; otherwise it would be advisable to retire the car.

When a car reaches the age that the retirement would cause a charge to operating expense less than the cost of reconditioning, it is problematical whether or not it is advisable to retire the car. No set rule as to this can be applied, but individual cases and conditions must be considered from every angle, such as the value of the parts which can be reclaimed from the retired car to repair remaining existing equipment, the capacity and value of the car from a loading standpoint and the probable cost of future maintenance. This is a matter of vast importance, however, and to handle it in a haphazard manner without the subject being thoroughly analyzed by those who are enabled to view it from every phase, will result disastrously, seriously affecting operating expense and maintenance of equipment costs.

THE CANADIAN PACIFIC has completed work on two K-1 class locomotives, 4-8-4 type, in its Angus shops. One of these, No. 3100, has already been placed in operation. This locomotive has a weight of 424,000 lb. and a tractive effort of 60,800 lb. equal to 3685 hp. It is said to be the largest passenger locomotive in the British Empire and has a boiler pressure of 275 lb.; the length of the engine and tender is 97 ft. 5 in.; the driving wheels have diameters of 75 in., and the cylinders are 25½ by 30 in. The tender has a coal capacity of 18½ tons and a water capacity of 12,000 gal.

A portable work bench for the machinist

THE top of the portable work bench, shown in the illustration, is of wood covered with sheet metal and bolted to an angle-iron frame which, in turn, is supported by the legs, also made of angles. Four light braces

A portable work bench for the machinist

from the middle of the underside of the top stiffen the vertical legs. The 5-ft. tongue, used for pulling the bench, is turned beneath it when not in use. The bench is 6 ft. long, 2 ft. wide and has a small vise mounted at one corner.

Moving car wheels with a shop mule

WHEN it becomes necessary to change a pair of wheels at some point distant from the repair track at the Denver shops of the Union Pacific, large hooks of 1½-in. steel, connected by a cross-bar of the same

Moving a pair of wheels with a shop mule

material, are attached to the axle of a pair of mounted wheels. The hooks are three feet apart and a short chain completes the circle of each, preventing them from flying off the wheels in traversing rough ground. The device is attached to the axle of the tractor by two chains.

Traveling engineers hold thirty-sixth convention

Meeting at Chicago considers future improvements in locomotive design and operation—Automatic train control discussed

NOT satisfied with the improvements in design and operation that have characterized the past few years of locomotive history, it is evident that those responsible for future improvements have a clearly defined program ahead of them further to improve conditions of operation as well as those of maintenance. This, in a few words, gives a picture of the thirty-sixth annual convention of the Traveling Engineer's Association held at the Hotel Sherman, Chicago, September 25 to 28. The enthusiasm of the meeting may have been enhanced somewhat by the ideal Fall weather which was a welcome contrast to that which prevailed during the days of the 1927 meeting.

The convention was opened by an address by the president, J. D. Heyburn, (St. L.-S. F.) who said that the traveling engineer is to good locomotive service what the locomotive is to transportation and added: "With the application of many new locomotive devices the traveling engineer must learn how each functions, and teach the crews the correct method of their operation. Today, with the competition of other forms of transportation, the advance in the cost of railway materials and the constant cry for reduced rates, the railroads are forced to practice economy and the traveling engineers must do their utmost to contribute to these economies by improved locomotive service."

J. D. Heyburn (St. L.-S. F.)
President

The convention was addressed by the Hon. Frank McManamy, Interstate Commerce Commissioner, and by A. G. Pack, chief inspector, Bureau of Locomotive Inspection, Interstate Commerce Commission. In addition, during the four-day session, the following reports and papers were presented and discussed: Further possibilities of fuel conservation—Both coal and oil, chairman, D. I. Bergin, assistant general road foreman of engines and general fuel supervisor, Wabash; Best method for successfully handling locomotives in extended service, chairman, D. L. Forsythe, general road foreman of equipment, St. Louis-San Francisco; Automatic train control, a paper by W. C. Kelley, supervisor of automatic train control, Illinois Central; Train handling, chairman, J. P. Stewart, general supervisor air brakes, Missouri Pacific; The effect of design of front ends, grates and ash pans on locomotive operation, a paper by F. P. Roesch, Standard Stoker Company, and a report on Internal combustion engines, chairman, R. A. Phair, division master mechanic, Canadian National.

Election of officers

The following officers were elected for the coming year: President, James Fahey, traveling engineer, Nashville, Chattanooga & St. Louis; first vice-president, Ralph Hammond, road foreman of engines, New York, New Haven & Hartford; second vice-president, R. A. Phair, division master mechanic, Canadian National; third vice-president, H. B. Kelly, general road foreman of engines, Pittsburgh & Lake Erie; fourth vice-president, J. M. Nicholson, fuel conservation engineer, Atchison, Topeka & Santa Fe, and fifth vice-president, A. T. Pfeifer, road foreman of engines, New York Central. W. O. Thompson (New York Central) and D. Meadows (Michigan Central) continue to serve as secretary and treasurer, respectively.

The addresses

Mr. McManamy, speaking for the greater part extemporaneously, commended the members of the Association for their contribution to the cause of greater safety in railroad operation by promoting an improvement in locomotive condition and operation. He touched on the work of the association in the matter of fuel conservation and emphasized the value of the mechanical conventions as a means for the education of railroad men. In speaking along these lines he said that a member of an association benefits from his contact with an association in proportion to the extent he contributes. Mr. McManamy quoted statistics to show the improvement in operating conditions and, in speaking of maintenance, cited the fact that in 1923 the ratio of maintenance of equipment expenses to operating revenue was 23.1 per cent. This figure, by 1926, had been reduced to 20.1 per cent while, at the same time the number of locomotives found defective by I. C. C. inspectors had dropped from 65 to 40 per cent. The former figures, said Mr. McManamy, are significant because the operating revenues for the years 1923 and 1926 were practically the same.

Mr. Pack, in discussing the responsibilities of the traveling engineer said in part:

"The success of the traveling engineer is attested by the fact that he is generally recognized as a key man in the present day operation of our railroads, and by the fact that many have moved to higher positions of responsibility, not only in railroad service but in other lines of activity. They have been weighed in the balance and not found wanting, and they will be again weighed in accordance with their accomplishments.

"We are in the midst of a new era in locomotive design and construction. Locomotives now in use may be looked upon by some as the ultimate, but if we are to use the past few years as a criterion, we may arrive at the conclusion that the best of today is merely a forerunner of tomorrow. The steam locomotive will, no doubt, have keener competition as time passes and it

may be subjected to many changes and refinements. This, together with the introduction of locomotives propelled by other forms of power, will necessitate constant study to keep up with the trend of the times.

"We are reaching out for higher average speed, longer locomotive runs, increased mileage per locomotive, per day and per month. The desired result is more work per unit of hauling power. Much has been accomplished in this direction and much more may be possible. The increase in load per train in 1927 as compared with 1920 was about 23 per cent, while the increase in average tractive force for the same period was about 17 per cent. This substantial increase in loading per unit of power, coupled with more intensive use of locomotives and higher average train speed, has enabled the railroads to perform a service which a few years ago would have seemed impossible of attainment.

"Trains are being handled with less delay. Movement of traffic is being expedited as never before accomplished in the history of the railroads. Heavier tonnage is being hauled while at the same time the consumption of fuel is being reduced. An average of about 131 lb. of fuel was required in 1927 to haul 1000 tons of freight and equipment one mile. This is the lowest known average ever attained.

"There will be continuous demand to increase train loads, more intensive use of locomotives, higher average train speeds, and increased fuel economy. This will bring a variety of problems which the traveling engineers will be called upon to help in solving. It therefore behooves us to cultivate flexible judgment and adaptability, because the accepted practices of today may become obsolete tomorrow and if we insist upon following methods and practices which are not of the best in the light of changed conditions, we will be left far behind in the march of progress.

James Fahey (N.Y.C. & St. L.)
First vice-president

"Engineering, mechanical and operating improvements are bound to continue. But great as the possibility of such improvements may be, we are approaching the time where success in the future will be more and more dependent upon the management of men—leadership. Selecting, training, guiding, and seeing that the work of enginemen and firemen is performed in the safest manner and under the safest conditions possible is a most important part of your work. Every man's attitude toward his work is largely influenced by the attitude of those in positions of authority and nothing will contribute more toward success than the cultivation of friendly feelings and mutual confidence.

"We have given profound thought to the evolution of the locomotive and we must recognize that the human being is in a state of evolution, ever reaching out for higher education and the better things of life; higher refinement and greater self respect. Harsh and unfair discipline, lavishly applied in the past, is fast giving way to more modern methods of management—employee relationship. There is nothing idealistic or socialistic in this change, because it is now becoming well recognized that respect for the moral rights of others, and far-seeing mutual self-interest are essential in obtaining a full measure of success, and for the advancement of the human race in accomplishing the better things of life.

"Your endeavors and mine are not unlike. Promotion of efficient and economical operation of locomotives is your objective—mine is the promotion of safety. You seek dependability of service, and reduction in the cost per unit of work—I seek reduction of accidents resulting from failure from any cause, of locomotives or tenders or appurtenances thereof. These objectives can be obtained only through the same mediums; i. e., the highest practicable standards of design, construction, maintenance and operation of all parts and appliances of locomotives and tenders.

"The relationship between the condition of locomotives and safety for employees and travelers upon the railroads is well illustrated by the tabulation here given, which shows for each of the past six fiscal years the percentage of steam locomotives inspected, by Federal inspectors, found defective, together with the number of accidents that occurred during each of the years:

Ralph Hammond
(N. Y. N. H. & H.)
Second vice-president

Fiscal year ended June 30	Percentage of locomotives inspected found defective	Number of accidents
1923	65	1348
1924	53	1005
1925	46	690
1926	40	574
1927	31	488
1928	24	418

Our records show that the number of persons killed as a result of some part or appliance of the locomotive or tender was reduced from 72 during 1923 to 30 in 1928, and that the number of persons injured from the same cause, was reduced from 1560 in 1923 to 462 in 1928, or a reduction of 58 per cent in the number killed and 70 per cent in the number injured.

"There is one class of accidents, however, upon which it may be well to say a few words—I refer to boiler explosions caused by crown sheet failures, the severity of which may be expected to increase in proportion to the increased size of boilers and higher steam pressures carried. It is said that the frailties of human nature are responsible for many accidents of this character, with which I agree; nevertheless, we should not look upon such occurrences as inevitable because much can yet be done to alleviate the situation.

"The use of the safest practicable firebox construction, especially within the area which may be exposed to overheating due to low water; the application of modern appliances such as Thermic Syphons, the application and working of which is now well established; the use of reliable feedwater appliances which may be conveniently operated and the working of which may be determined without the necessity of enginemen endangering their lives by leaning far out of the cab window; the construction, application and maintenance of water glasses, water

columns and gauge cocks that will accurately register the water level in the boiler under all conditions of service, so located and maintained that the engineer and fireman may obtain quick and accurate readings from their usual and proper positions in the cab without materially detracting their attention from other important duties, will do much to prevent and relieve the distressing results from crown sheet failures caused by low water."

Report on means of securing fuel conservation

Present-day operating schedule represents passenger and fast freight service, as means of producing revenue, resulting in light tonnage and high speed even though modern power can haul its maximum tonnage at a lower basic cost and resultant less pounds of fuel per 1,000 gross ton mile at moderate speeds.

Class I railways in the United States spent in 1927 $310,869,524 for coal and oil for road locomotives in freight and passenger service (charged to operating expense). This is to be compared with $327,465,482 in 1926. In 1927 the roads consumed 95,459,840 net tons of coal at an average cost of $2.66 per ton, compared with 101,155,412 tons in 1926, at an average cost of $2.63 per ton. They also consumed 2,042,137,055 gal. of fuel oil, slightly less than in the year before, at an average cost of 2.81 cents per gal., as compared with an average of 2.95 cents the year before. The expense for oil was $57,326,689 as compared with $60,938,230 in 1926.

In 1920 fuel consumption in freight service amounted to 197 lb. per 1,000 gross ton mile (excluding locomotive and tender). In subsequent years the corresponding fuel consumption was as follows:

1921	185 lb.
1922	186 lb.
1923	183 lb.
1924	170 lb.
1925	159 lb.
1926	155 lb.
1927	148 lb.

In the passenger service the fuel consumption per passenger train car mile amounted to 18.8 lb. in 1920. In subsequent years the corresponding fuel consumption was as follows:

1921	17.7 lb.
1922	17.9 lb.
1923	18.1 lb.
1924	17.0 lb.
1925	16.1 lb.
1926	15.8 lb.
1927	15.4 lb.

No doubt, the pounds of coal per passenger car mile would have reflected a larger saving but for the approximate increase in weight of passenger car equipment of 10.5 tons since 1920. Calculated on the basis of traffic handled in each year since 1920 and the average price of fuel in these years, this increased efficiency in fuel consumption as compared with 1920 records has resulted in a fuel saving of $283,437,000 in the freight service and $73,684,000 in passenger service since 1920.

On a level grade at a speed of 20 miles per hour it requires 460 lb. tractive effort to haul 50 tons in two cars of 21 tons weight. It requires only 270 lb. to haul 50 tons in one car of the same weight, or 41 per cent less. To haul the same car and contents at 40 miles per hour increases traction from 270 to 412 lb. or 53 per cent; hence the importance of heavy car loads and moderate speeds.

Distribution of fuel

Keeping an accurate record of all fuel purchased and issued is a matter of bookkeeping or accounting. The system followed should be such that the records would show at any period (not less than 30 days apart): The exact amount of fuel purchased; the exact amount of fuel on hand and where; issues by month with a subdivision or separate charge for all different uses of coal; the exact amount delivered to locomotives and used solely to produce transportation.

Feed water treatment

Clean and dry boilers, free from scale and free from leaks, are paramount in fuel conservation. To attempt to operate scale-insulated boilers results in a loss of boiler capacity and engine efficiency; increased back pressure, due to restrictions in exhaust nozzle size required to burn larger quantities of fuel per square foot of grate area per hour as a whole; loss due to too high a flue-gas temperature; and increased cost of boiler maintenance.

In connection with the above subject, reference is made to the comprehensive report on "Effect of Feed Water Treatment," in the 1927 Proceedings of the Traveling Engineers' Association, by W. A. Pownall, H. B. Kelly, J. W. Wells, W. L. Robinson, and P. E. Keenan.

Answer to questionnaire

The committee sent a questionnaire to all members, the answers being summarized in each case in the report of the committee.

Question No. 1.—What method is in use on your road for supervision and education of engine crews?

Answer: Personal supervision through contact on the deck of the locomotive is apparently the major method in use to supervise and educate enginemen. Some roads report excellent results and live interest being maintained through the use of cars equipped with locomotive appurtenances, stokers, valve gear models, model cylinders and locomotive appliances. Combustion cars are also being used with excellent results. Cars over one line are maintained by employees of the road; instructors give lectures on combustion, fuel economy, breakdowns, and the correct operation of locomotive devices, showing moving picture films on firing practice, breakdowns, economical practice of operation and boiler operating conditions. The showing of movie films is a modern method being resorted to by different roads and is reported as giving excellent results in stimulating further interest among employees.

Question 2.—What method is used for employment of new men?

Answer: The trend of practice reported is to hire men from along the line conforming to age and physical requirements; some roads insisting on the applicant having eighth grade or high school education. Some give preference to men in the roundhouse. All roads require the student to make the necessary number of trips in order to be OK'd by the engine man and supervisory officers as ready to enter active service. Some roads report the use of first-, second- and third-year progressive examinations.

Question 3.—Does your road use a standard form for road supervisory forces, road foremen, fuel supervisors or traveling firemen?

Answer: All answers indicate the use of a report containing information required by the government pertaining to locomotive requirements as imperative. Reports, as a rule, are going direct to the master mechanic and general foreman. The prevailing method indicates daily reports from the supervisor, followed by a weekly

letter covering activities, showing date, train number, points ridden from and to, engine crew, etc., following with a report on defects observed and the general condition of the power unit.

Question 4.—Are monthly divisional fuel meetings held on your line?

Answer: The answers received report excellent results relative to monthly fuel meetings for all employees with the division superintendent in charge, and divisional, mechanical and transportation supervisory officers in attendance. Other roads report the same general practice with staff meetings instead of employees' meetings, with a fuel conservation committee appointed from employees' on the line.

Question 4-A.—What form of report is available on fuel performance? Nature of report and extent used?

Answer: Records available indicate the system and divisional fuel performance of the different divisions, non-productive costs, covering cost of initial and terminal delay, dead-heading and called and released, etc., discussed at fuel meetings. These serve to bring about friendly rivalry among the different divisions. Some roads report all delays taken from the train sheet or conductors' reports on freight and passenger trains and compiled for comparative purposes by districts; also for purpose of indicating fuel burned which is not used in producing transportation.

A. N. Boyd
(Canadian National)
Third vice-president

Question 5.—Transportation activities, trainload and operation, effects observed in conservation of fuel?

Answer: The answers indicate that results in performance secured depend on the attitude of division officers. Attendance at fuel meetings by train crews and other department employees gives good results. Some roads use the "19" order exclusively to eliminate delays and to assist train operation.

Approximately 90 per cent of the fuel consumed by locomotives on our railroads represents a transportation charge. The remaining 10 per cent is due to causes resultant with the service. Economies effected are due to the offensive instead of defensive methods being observed by those in charge of railroad operation, indicating the necessity of individual willingness to serve on the part of all concerned from the general supervisory officers to employees of the lowest rank in all departments involved in sustaining a policy of operation, expenditures, assignments, care, maintenance and ultimate performance of the locomotive engaged in moving transportation over our railroad lines.

Question 6.—What is the maximum amount of coal permissible to use per square foot of grate area in firing up locomotives in roundhouse?

Answer: Reports indicate that the use of 13 to 15 lb. of coal per square foot of grate area for firing with bituminous coal give the best results. Two roads report the use of paper over the grate area at a cost of seven to nine cents for paper used on each engine, with a resultant saving of 200 lb. of fuel or more on each engine fired. A good firebed condition when leaving the outbound terminal is a desired factor.

Question 7.—What added efficiency and economy, also dependability, have been secured with the application of the force-feed lubricator over that of the hydrostatic type?

Answer: The answers indicate that it is a modern and safer method; engine men are relieved of adjustments while enroute; it gives a 10 to 20 per cent saving in oil; no oil feed at stand-by periods; also, savings are dependent on results of careful adjustment of feeds, without drawing too close a line; uniformity of lubrication under all operating conditions, and the crew is relieved of anxiety of lubricator running out during the trip. There is a saving in time where locomotives are operated by more than one crew in all classes of service. The top portion of cab interior is more accessible for cab work and proper inspection of other devices.

Question 7-A.—What results are observed between single feed and oil pipe to valve and cylinders over that of individual feed and pipe lubricating both the valve and the cylinder?

Answer: The answers specify trouble experienced in lubricating valves and cylinders with a single feed; this is most noticeable where the lubricator drive shaft is coupled to the top of the combination lever, which brings about a variable lubricating condition. No trouble is reported as experienced with the above type of hook-up on locomotives in switching service. The general idea is that experiments point out that individual feed and pipe to the valves and individual feed and pipe to the cylinder is the most efficient and economical method of application. Some roads report trouble to lubricate properly at high speeds where the single feed and oil pipe entering the steam pipe lubricates the cylinder and valve with drive shaft connected to the top of the combination lever. Where drive has been changed to fixed point of link trunion, better results have been reported.

W. O. Thompson (N.Y.C.)
Secretary

Question 8.—What auxiliaries, if any, in use on your line utilize superheated steam for operation?

Answer: The answers indicate those in use as in the experimental stage; the results secured indicate the use of superheated steam to operate blowers, stokers, air compressors, boosters, generators and feedwater heaters.

Question 8-A.—Has lubrication trouble, if any, been experienced with auxiliaries operated with superheated steam?

Answer: The answers indicate still in the experimental stage with no report available.

Question 9.—What percentage of power have you equipped with feedwater heaters and exhaust steam injectors?

Answer: The information received indicates continued application of feedwater heaters and exhaust steam injectors. The report of 1924 indicated 3.4 per cent or

2,277 feed water heaters. Application of feed water heaters up to July 1, 1928 represents 6.66 per cent of locomotives, as a whole, equipped, with 4,675 heaters applied. Exhaust steam injectors applied up to July, 1928 are 557 or 0.79 percent of the locomotives equipped.

Question 9-A.—Results obtained as between different types of feedwater heaters and exhaust steam injectors?

Answer: The answers indicate variable to 15 per cent saving with feedwater heaters over injector operation and variable to 8 per cent saving with exhaust steam injectors over injector operation.

Some roads answer that the percentage of savings is noticed only in savings in water station stops.

Question 9-B.—Increase or decrease of average train speed over line, if any, through use of feedwater heaters?

Question 9-C.—Increase of tonnage, if any, by use of feedwater heaters—reduction of back pressure observed at maximum operating condition with feedwater heaters as against locomotive with injector operation?

The answers include Questions 9-B and 9-C, indicating lack of test data. There are, however, opportunities for further fuel savings with increased capacity through the use of suitable feedwater heaters. Several roads report elimination of one water stop over the line of road due to feedwater heaters, with a resultant increase of gross ton miles per train hour. Replies indicate reduction of three to six pounds back pressure observed with locomotives feedwater equipped as compared with injector operation.

Question 10.—Percentage of locomotives on your line in freight, passenger and switching service equipped with 9½-in., 11-in. or 8½-in. cross-compound air compressors?

Answer: The data received is insufficient to warrant an answer; however, a table was given in the report indicating further efficiencies and economy in fuel and water offered by manufacturers in favor of 8½-in. cross-compound air compressors over that of the single phase type of compressor.

With an engine equipped with two 11-in. air compressors and with a train having a brake pipe leakage of six pounds or more per minute from a pressure of 55 lb. after a service reduction of 15 lb. in the brake pipe had been made, or the pressure in the brake pipe drawn down from 70 to 55 lb., the displacement of one of the air compressors is practically lost in the pumping of the leakage throughout the train.

Question 11.—Percentage of locomotives in freight, passenger and switching service equipped with superheater device?

Answer: The superheater equipped type of locomotive needs no comment as to its having been the outstanding attribute of capacity and efficiency with economy in giving new life blood to the saturated locomotive. Records indicate that on July 1, 1928, there were approximately 54,169 locomotives equipped with superheaters.

Fuel oil

At the present time 7,304 locomotives are using oil as fuel, and the total number of gallons burned in 1927 amounted to 2,042,000,000, valued at $57,300,000.

Burners

Steam atomizers (or burners) in most general use on all oil-burning railroads are of simple construction, being just a conduit for oil with a mixture of steam. These steam atomizers are without patent protection in many instances, and consume from 3 per cent to as high as 7 per cent of the total steam output for atomizing purposes. This offers a field for possible economies in the use of mechanical atomizers, but to date no oil-burning road is making use of this type of burner insofar as is generally known. One of the disadvantages that must be overcome in the use of mechanical atomizers is the limited capacity; either enlarging the capacity or placing two mechanical atomizers seems to be the only method of overcoming this handicap.

On some of the larger types of locomotives fuel oil consumption at times reaches a maximum of 500 gallons per hour, which is considerably beyond the capacity of any mechanical atomizers that your committee knows of. The cost of the present oil burner is about $15 each, while mechanical atomizers with necessary auxiliaries cost approximately $300.

Martin water tables

On oil-burning locomotives where the fire-pan is standard equipment there seems to be a field for possible economies through the installation of water tables, which take the place of the ordinary fire-pan and increase the heating surface through the elimination of approximately 500 fire-brick, which at the present time is used for bricking the floor and side-sheets of the conventional oil-burning fire-box.

On the Texas & Pacific, where one of these water tables has been in use on an oil-burning locomotive, a saving of 11 per cent in fuel has been reported.

Longer locomotive runs

With oil as locomotive fuel the possibilities for greatly extending locomotive runs is constantly receiving serious thought and much fuel is being saved through this practice. Oil as a fuel offers greater opportunities in this respect than coal, as the condition of fire with respect to clinker and cinder formation is eliminated.

One case of fuel saving that has resulted from longer locomotive runs may be cited between Los Angeles, Cal., and El Paso, Texas, a distance of 888 miles. In this territory, under the old method, it required 50 locomotives in passenger service, while under the present plan for running locomotives through it requires but 25. Four locomotive changes have been eliminated in this territory and the annual fuel saving alone amounts to approximately $32,000, while large savings are indicated in capital investment and in labor savings due to the elimination of intermediate terminal forces.

Remote control switches

Through the use of remote control switches, which reduce the number of train stops, another possible saving method is practical. Where these mechanisms are installed, a train taking a siding to meet or be passed by another train, all stops are eliminated with the possible exception of one stop. The switches are being controlled by the dispatcher or operator. The estimated cost of stopping a freight train is between $2.00 and $2.50, the largest item of which is fuel. If we can eliminate a number of these stops in handling a train over a district, the possible fuel savings are worth while.

Another method which is attracting considerable attention at the present time is the elimination of train orders and handling of trains by remote control through the train dispatcher.

The report was signed by D. I. Bergin, (Chairman), Wabash; J. N. Clark (S. P.); J. J. Kane (L. V.); K. C. Simino (S. P.); J. Vass (C. N.) and F. C. Wenk (A. C. L.).

Discussion

J. B. Stuart, air brake supervisor, Missouri Pacific, discussed the effect of eliminating train orders and train stops upon fuel conservation. He described an installation of remote switch control on the Missouri Pacific where trains now enter switches at 35 m.p.h.; controlled by light signals instead of train orders, at a great saving in fuel and overtime by dispensing with the train stop. The time is coming, declared Mr. Stuart, when the "19" and "31" train orders are going to be curiosities in transportation.

E. P. Ragsdale, Southern Pacific, estimated that remote switch control on the Southern Pacific, by allowing trains to meet and pass each other without stopping, reduces the consumption of fuel oil from 50 to 75 gal. per locomotive for each meet. It was his opinion that further fuel savings in oil-burning equipment are dependent upon further improvements in the equipment itself. He said: "We must get away from the necessity of using firebrick in oil-burning fireboxes. It takes from 15 to 25 min. to get the brick heated properly for efficient oil burning whenever it has been cooled down by stopping at sidings or elsewhere." Expressing the opinion that we are just in the experimental stage of developing and perfecting oil burning apparatus, Mr. Ragsdale advocated more experimentation with atomization of oil to stop the waste of fuel, and predicted that draft regulation will be provided for oil-burning equipment that will restrict the air openings to the location of the burner itself while the locomotive is not in motion.

The New York Central, according to John Brennan, operates 27 oil burners on its Adirondack division from 8 a.m. to 8 p.m. during the season from April 15 to November 1 each year in order to comply with the forest fire regulations. It successfully operates on these engines with a brick arch like that used in coal-burning power without experiencing any leaking of crown bolts.

Roy Hunt, Atchison, Topeka & Santa Fe, cautioned against accepting too readily statistical reports of fuel-savings or other reductions in connection with lubrication and fuel-saving devices because of the lack of authenticity in such figures, and added his opinion to that of Mr. Ragsdale that the method of burning oil in locomotives must receive more attention and that, in view of the probable necessity of the railroads using lower grade fuel oil in the future, the development of atomization is increasingly important.

The statements in the committee's report purporting to discourage the practice of traveling engineers to keep on demonstrating to employees their ability to operate locomotives was vigorously opposed, and it was the expressed opinion that the traveling engineer should always be prepared to follow up his instructions by example. In this connection J. Cronin, Illinois Central, described his long-continued practice of holding classes every Friday morning for enginemen and every Friday afternoon for trainmen to familiarize them with the handling of equipment. No charts or text matter are used and any subject may be discussed. In all instances the enginemen and trainmen are given the chance to inquire about their problems without being ridiculed and have the assurance that a solution to the problem will be furnished, if possible, by demonstration. Interest of this kind by the traveling engineer in the education and training of engine crews, in the opinion of Mr. Cronin, is as important to economical and efficient locomotive operation as the mechanical improvements that have been made.

Automatic train control installation and maintenance

To the date of writing this paper there have been two orders issued by the Interstate Commerce Commission requesting roads to install and maintain a device that will automatically apply the brakes, bringing the train to a stop when approaching an occupied or restricted block.

There were 44 roads named in the first order and 36 in the second order. The progress of the installations as of July, 1928 has been as follows:

	First	Second
Roads involved in orders	44	36
Roads exempted in orders	4	6
Roads having dates of completion indefinitely suspended	1	5
Roads having installations completed	44	35
Roads that have been inspected by the Interstate Commerce Commission	40	25

Road miles to be equipped, both orders	8,392.76
Track miles to be equipped, both orders	14,931.80
Percentage of total track miles completed	98.5

At the time the Interstate Commerce Commission order was issued, there were many designs of equipment that had been worked out by various designers. The characteristics of these various designs were as follows:

1—Continuous induction using cab signal, with mechanical speed-control governor, which restricted the speed of the train according to restrictions of aproaching block.

2—Continuous induction using cab signal, with automatic control application valve to apply the brakes when cab signal changes from clear to restrictive indication when approaching an occupied or restricted block.

3—Intermittent induction with automatic control valve, which will apply the brakes when passing a signal indicating caution or stop.

4—Intermittent contact with automatic control valve, which will apply the brakes when passing a signal indicating caution or stop.

The total track mileage of the various types installed up to July, 1928, is as follows:

Continuous induction with cab signal and governor speed control	3,551.33
Continuous induction with cab signal and automatic stop application valve	6,139.40
Intermittent induction with stop application valve	8,846.
Intermittent contact with stop application valve	872.
Total track miles	19,408.73

The number of locomotives to be equipped with the various designs is as follows:

Continuous induction with cab signal and governor speed control	1,175
Continuous induction with stop application valve	3,016
Intermittent induction	4,191
Intermittent contact	310
Completed installations	7,339

Some roads have made voluntary installations, which were not included in the above. These are as follows:

Track miles of various types	4,569
Engines to be equipped	759

Train control characteristics

The characteristics of the different types from an operating standpoint are only two; namely, continuous and intermittent, and are arrived at by the operating characteristics of each.

The meaning of continuous control is self-explanatory; that is, the indication of the condition of the approaching block is continuously indicated by the cab signal light indicators, located in the cab as near in line of the engineman's vision as possible. This indicates to the engineman any restrictions that may occur after passing a caution signal the instant such a condition should occur which otherwise he may not be able to observe (on account of his vision being restricted by curvature of the track, by stormy weather, fog, etc.),

thus enabling him to take immediate action that may be necessary to reduce the speed of his train before reaching the obstructed point. Also, when running under restricted speed indication, the engineman is instantly advised when speed may be increased, by change of cab signal to a less restricted indication, due to the cause for restriction being partially or completely removed, which would be caused by a train in the block, a switch not properly lined, a broken rail or a car fouling the main track.

Different roads use different signal indications in the cab, some using two indications; namely, clear and low speed, while other use three indications; namely, clear caution and low speed. The cab signal indications are designated in various ways. Various roads have accepted as their standard color lights, position lights, and the letters H. M. L., meaning high speed, medium speed and low speed.

Some roads have installed the continuous system and use it in conjunction with permissive wayside signals that were in service prior to the continuous control. Others installed it on territory which was not equipped with wayside signals, installing them at the same time. Some installed the continuous control where there were no permissive wayside signals and operate by the cab signal exclusively. Some roads are making installations of the continuous control on territory equipped with permissive wayside signals and have removed the signals and operate exclusively by the cab signals, which has proven very satisfactory from an operating and maintenance standpoint.

The name "intermittent control" was also arrived at by the operation characteristics of the device; that is, the communication between the track and engine is at the wayside signal only. The intermittent devices were designed to operate exclusively with the wayside signal, there being two different types of designs, namely the intermittent inductive and intermittent contact ramp type.

The two different designs function in practically the same manner as related to the permissive wayside signals; that is, should a signal indicating "caution" or "stop" be passed, the brakes would apply, bringing the train to a stop.

After passing a clear signal, with the intermittent control, the engineman has no warning of any restriction that may occur until he is in view of the approaching signal.

When passing a signal indicating caution or stop, it is necessary for the engineman to operate the so-called forestalling or acknowledging lever (which is located conveniently) to avoid an automotic control application, bringing the train to a stop. Such an action on the part of the engineman indicates that he is aware of the restricted signal he is passing.

On roads where the continuous control is in service without the permissive wayside signal, when the cab signal changes from a clear to a caution or slow indication, the engineman may be operating the forestalling lever and reducing the speed as per transportation rules according to the indication the cab signal is displaying, but is not required to stop unless the cause for the restricted indication is not removed, therefore eliminating stops when following a train ahead.

Methods of restricting train speed

Some roads use a mechanical speed-control governor for restricting the speed when running under restricted cab signal, others restrict the speed by rules; both ways have worked out very satisfactorily, each system having merits of its own. Continuous control with the mechanical speed governor prevents the engineman from exceeding speed limits when running with restricted cab signal, which is sometimes done by the engineman misjudging the speed of his train. On the other hand, continuous control with an application valve is more easily handled as the applying of brakes is entirely in the hands of the engineman after the forestalling lever has been operated, which allows the reduction of speed to be made in the most satisfactory manner according to the conditions existing.

There are various methods of automatically venting the brake pipe, thus applying the brakes. This has been accomplished as follows: Movement of rotary valve in the engineman's brake valve by an accuator which vents the equalizing reservoir pressure in same manner as when operated manually; design of a complete new engineman's brake valve with all the operating requirements for applying the brakes has been used very extensively; it also vents the equalizing reservoir at the same ratio as is done with the brake valve handle in service position.

Some roads use a limiting reduction reservoir so connected that by lapping the brake valve immediately after the reduction starts the venting of the brake pipe will be only a few pounds under a full service reduction.

Some designs vent the brake pipe direct through a restricted port.

It should be understood that all the different devices must be so designed that when the brake pipe is being vented, thus applying the brakes, there is no possible way to recharge the brake pipe when it is being vented; also, the engineman must be able in all cases to make an emergency application of brakes at the same time the brake pipe is being vented, should conditions require such action.

The various manufacturers of train control and train stop devices have made several modifications since placing the equipment in service, which has considerably reduced the number of failures, simplified the equipment and reduced the number of repair parts necessary to be carried in stock.

A great part of the development and successful operation of train control and train stop has been due to the hearty cooperation on the part of the enginemen observing any undesired operation of the device and promptly and correctly reporting to the maintenance forces needed signal and shop maintenances, which enables them to make tests and locate and make repairs intelligently, and it is hoped this good work will continue as all concerned are becoming better acquainted with the various devices.

The paper was signed by W. C. Kelley, supervisor of automatic train control, Illinois Central.

Discussion

During the discussion of this paper one member made the statement that, in his opinion, the factor of added safety attributable to the installation of train control equipment has not proved equal to that which would be obtainable by the expenditure of a similar amount of money in other ways. Another member outlined the details of an installation of train control equipment in a territory where wayside signals had never been installed and, from the experience in operating trains over this territory, expressed an opinion in favor of the use of cab signal indications without the use of wayside signals as a future possibility. On being questioned as to the method of train operation in the case of a failure of the automatic control he mentioned that the type of equipment in

use consisted of color-light indications in the cab, as well as audible whistle signals, with the usual actuating equipment on the brake valve. He said that it was indeed unusual when both the audible signals and the color-light indication in the cab failed at the same time, but that, should such an emergency occur, the instructions to the enginemen, when on double track, were to proceed under restricted speed to the nearest communication station and operate their trains from that point under train orders.

Equipment conditions affecting train handling

Locomotive design should include careful attention to the location and capacity of the air compressors; to the location and capacity of the main reservoirs; to the location and capacity of the pressure governing appliances (particularly the feed valve which should be protected from the intense heat of the boiler head); to the arrangement of piping (the pipe that supplies the feed valve should take air from the top of the main reservoir supply pipe which should be equipped with dirt collectors equipped with proper drain cocks); to the location of the brake pipe connection to the distributing or control valve; to the size and quantity of pipe; to the method of clamping, and to proper provision for radiation and drainage. Air operated devices should, in all cases, be so placed that moisture will drain away from them rather than into them.

Even with the highest possible efficiency of locomotive design, the best results will not be secured unless in the design of the train equipment, the same care is exercised in providing a minimum resistance to the starting effort. If the brake shoes do not entirely clear the wheels, the starting effort must be increased, and the resulting losses should properly be charged to the guilty party.

In designing freight cars, consideration should be given to the empty and the loaded weights, and in cases where there is sufficient difference to make it inadvisable to associate the loaded car with the average car in service, such refinements should be provided in the brake rigging as will furnish a suitable brake effort for the car whether loaded or empty.

A. R. A. rules specify the dividing car weight between 8-in. and 10-in. freight equipment at 37,000 lb. The percentage of brake force is also specified as 60 per cent of the light weight of the car, based on 50-lb. brake cylinder pressure. It is highly important that the greatest care be given to the foundation brake design, in order that the brake cylinder force may be transmitted to the brake shoes with the highest possible efficiency. The brake levers should be of suitable lengths and proportions to provide against losses from improper angularity.

Maintenance of locomotives

While perhaps second in importance to original design and installation, proper maintenance is absolutely necessary if we expect to receive the benefits of modern appliances. We desire, therefore, to impress upon all the necessity for both the incoming and outgoing tests of locomotive appliances. The double test may not seem important, but if the test of air brake appurtenances, boosters, injectors, sanders and other appliances is not made until just before departure, the defects then found, in order to prevent delays, will be permitted to pass into service without correction, while, if only the incoming tests are made, no check test would be provided for the work performed in the shop or engine house.

We believe that the orifice test of air compressors should be made more frequently. In our opinion this test should be made every 30 days and we therefore recommend this change in practice and in the wording of the cab card.

Maintenance of cars—Passenger and freight

Where correct design and installation have been obtained, the maintenance of air brake equipment, foundation brake gear, draft rigging, etc., on both passenger and freight cars, resolves itself into the provision for daily inspection, including tests, adjustments and light repairs, and a more thorough inspection at regularly appointed inspection periods, during which the equipment is carefully examined, necessary replacements made, and wear of parts corrected to a degree which will put the equipment in condition to perform its functions until the next inspection period.

The draft rigging on passenger and freight cars should receive periodical tests, made under pressure, to determine the actual extent of movement, and that corrections should be made when required. It seems at present to be a self-evident fact that draft rigging is not being regularly tested under pressure, and that consequently the free slack action becomes excessive and contributes toward rough handling of trains, both in starting and stopping.

Great assistance to better maintenance of freight car brakes, and, incidentally, to the better handling of manifest freight trains, will be provided if the yards and freight loading and unloading tracks are piped and provided with the necessary facilities for brake cleaning, light repairs and testing. Loaded freight cars, so handled, will, when placed in trains, be ready for prompt movement, and the inspection and work already done will increase the train brake efficiency, and will also tend toward reducing the time of train brake inspection before departure.

The rules for both the incoming and outgoing tests of freight train brakes have, through long experience and protracted effort, become effective and are familiar to all. With the requirements for train brake testing so well known, it seems unnecessary to make special mention of any particular feature, particularly as we are all law-abiding citizens who recognize our duty of strict adherence to the entire code. It is important, however, to emphasize the fact that where the general maintenance conditions are satisfactory, and the total brake pipe leakage does not exceed two or possibly three pounds per minute, there is generally little difficulty in starting or stopping trains without rough handling.

The thermal brake test

The thermal or wheel temperature brake test is the most accurate method of determining brake efficiency. After descending a grade, the hotter the wheels, the more braking was done, and any car that has cold wheels proves the inefficiency of the brakes on that car; as the braking force of a car is in proportion to its empty weight, the cars with the greatest empty weight in any particular train will have the highest wheel temperature where the brakes on all cars are in equally good condition.

The thermal test should be made where conditions favor, such as where stops are made to cool wheels, and cars with either cold or excessively hot wheels should be carded to indicate the brake condition.

[The remainder of the report dealt largely with the manipulation of the brake valve in controlling and stopping trains.—EDITOR.]

The report was signed by J. P. Stewart, Mo. Pac.,

(chairman); O. H. Bryan, West Pacific; J. M. Nicholson, A. T. & S. F.; J. J. Rossiter, N. Y. C., & St. L.; W. E. Vergan, M.-K.-T.; and F. B. Johnson, Westinghouse Air Brake Company.

Discussion

The discussion of the report was confined chiefly to the effect of air brake operation on train handling and disclosed much difference of opinion on the proper application under different operating conditions. The controversy centered chiefly upon the use of the independent brake in bringing trains to a stop. One member emphasized the importance of thorough air brake inspection on the cars of incoming manifest trains in order to assure the perfect functioning of the brake equipment on these cars after departure from a terminal in a train with other cars. The tendency is to neglect the cars of the incoming train in order not to delay the outgoing train. This neglect, he said, is one of the principal causes of rough handling on the road. The same speaker emphasized the importance of enginemen personally testing for leak-off before leaving a terminal, as a means of obviating road trouble.

Spring making and repairing

Abstract of a paper presented before the 1928 convention of the Master Blacksmiths' Association

By George Fraser

Blacksmith foreman, Atchison, Topeka & Santa Fe, Topeka, Kan.

CERTAIN essentials entering into spring manufacture and repair must be observed. Correct design is highly essential, as are also good material, furnaces that are pyrometrically controlled (both for setting and drawing temper), a proper quenching medium and presses sufficiently large to insure a tight band. In our shop we are fortunate in having such facilities. Many of our machines are of our own design and manufacture.

I am often asked "What is the life of a spring?" A spring properly made from good material and correctly designed should at least stay in service from one

Spring treating furnace (Six doors each side)—Quenching tank (Capacity 90 barrels)—Three trays, two down and one up

shopping to another unless it snaps from unusual shock.

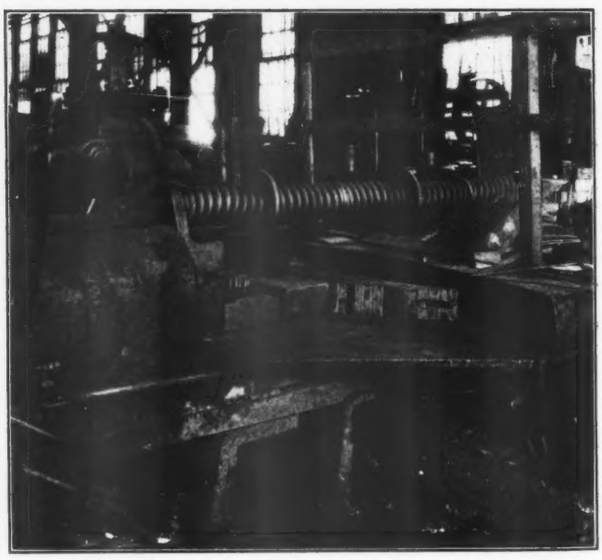
There will never come a time when we will not have failures, but the time is not far off when failures can and will be reduced. Failures from fractures in elliptic coach and tender springs are negligible, while in semi-elliptic locomotive springs they are a serious problem.

Leaves generally break under a sudden shock, and, if the truth were known, you would find 50 per cent of the failures in repaired springs due to defects in springs before going into service. All repaired springs are tested in a hydraulic press before banding. Out of every five springs tested, we break from one to three leaves, which proves the value of this method. One of the illustrations shows the press and some defective leaves.

Back camber springs superior

Expressing my views at our last convention on the convex or back camber spring, I was not in a position to make recommendations, owing to springs of this type being in service on our line only a short time. However, I am now fully convinced that they are far superior to the concave design, as the upkeep has proven less and they stay longer in service.

A spring that will give the best service is one that will conform to a uniform radius from end to end under the working load. In order to obtain a spring of this type, it has been fully demonstrated that not more than three full leaves should be applied to springs



Testing for defects before banding—One to three out of every five leaves break when subjected to slight reverse bend

having more than 60-in. centers. More than this number of full leaves when applied, produce a stiffer spring at the ends, throwing a greater strain at the center of the spring, which is one cause for failures.

A spring with five or six full leaves will jump back

under the release. The spring with three full leaves, under the release, will move to its original height gradually, which proves that the strain is equally divided.

The front truck spring of a locomotive undoubtedly receives a greater degree of hard usage than the driving spring, as proved by the greater number of failures which are mostly due to the springs being made too rigid, having no resiliency under a sudden shock and unequal working load. For these reasons, it would seem desirable to use a tougher and more elastic alloy steel in springs showing the greatest number of failures. I would recommend that they be made with a back camber, having leaves graduated in thickness from the center down.

In order to distinguish the difference between alloy steel and other grades, as springs come in for repairs, a special edge should be rolled in the making. The alloy steel spring will endure the greatest amount of deflection without having the load exceed the elastic

Front view of setting machine operated by compressed air—Hydraulic presses for nibbing and slotting conveniently located

limit. It moves through a considerable distance, carrying the required load with ease and an absence of that stiff and quick reaction.

Repairing springs

In repairing springs, we remove the iron bands cold with a hydraulic press. The spring is held stationary while the band is being shoved off, shearing an average of one nib of the second leaf.

It is not a safe practice to remove bands cold by pushing the spring through the band. Bands on all elliptic springs are sheared off and scrapped, new bands made from ⅜-in. by 3-in. refined iron being applied. Bands are formed and applied at the same heat and not welded.

This has been our practice for several years without a failure, which is largely due to the springs being crosswise of the car while locomotive springs are length-wise.

Springs with one or more broken leaves, if of correct dimensions, are repaired by replacing the broken leaves. Springs not up to specifications or dimensions are reset and allowed to normalize. The leaves are then cut to the proper length, the short leaf not extending more than 2 in. from the edge of the band. Old leaves of the same size, if smooth, are used again.

Making new springs

The leaves are straightened edge-wise, nibbed, slotted on both ends and set, all at the same heat, one leaf at a time. Straightening, nibbing and slotting holes are done on a hydraulic press. The leaves are set against a weight machine operated by compressed air, as illustrated. After setting, the springs are allowed to normalize until the next day, then being hardened and drawn. We figure a loss of temperature of 25 deg. between the furnace and the quenching. Three separate pyrometrically-controlled furnaces are used for the three operations.

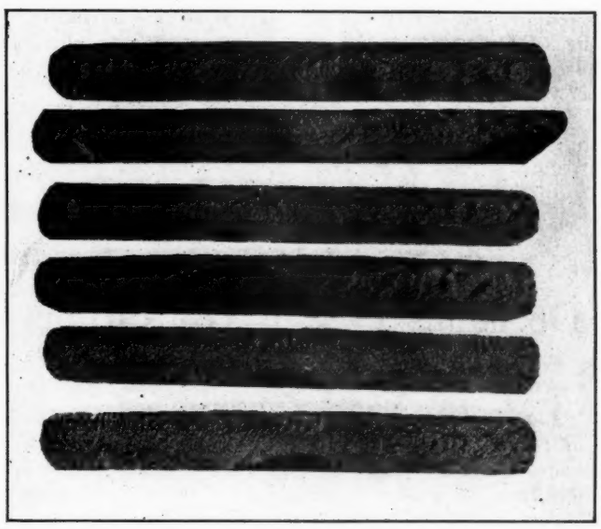
Temperatures used in spring making

	Deg. F.
Setting	1600 to 1650
Hardening	1475 to 1500
Drawing	800 to 850

Quenching oil should be kept at 150 deg. F.; Brinell, from 350 to 418.

To help eliminate the trouble from loose and shifted bands, we bob the edge with a bob punch on the first, third, fifth and seventh leaves from the top down. This impression extends out ¼-in. from the edge of the leaf, which beds into the hot band when it is applied on the engine springs.

New reinforced bands, made from refined iron, are applied to all locomotive springs, except trailer springs, which are equipped with cast steel bands. The heavier the band the longer it will stay tight. All clips are of



Broke in testing before banding—Typical defects and grain structure causing failures

cast steel. After banding, the springs are dipped in hot crude oil before testing.

Testing

The testing of springs is handled under the supervision of the engineer of tests, all springs being tested under the release method. When a spring is placed, it is measured for free height, which is termed original free height. The spring is then compressed with 1½ times its working load and released to its free height, which is again measured. This is called free height. The spring is again compressed with 1½ times its working load and released to the working load. This height determines whether the spring is accepted or rejected and, according to specifications, we are allowed ⅛ in. above, and ⅜ in. below the working load. When more than ⅜ in. below, the spring must be re-worked.

New springs are set from ¼ in. to ½ in. higher than working load, according to the length. On repaired

springs this depends on condition. They are set from ½ in. to 1 in. high, according to the length and the number of leaves. This is being done in order to make springs take a set in the testing machine to the proper height. Springs that are not made to take a set that comes within the specifications when applying 1½ times the working load, are not down to a permanent set and will take an additional set in service.

All springs are marked after test, and, as locomotives come in for general repairs, the springs are returned to the shop for re-testing. Springs, accepted ¼ in. and ⅜ in. below the working load and not made to take set, are found from ½ in. to ⅝ in. low. Such springs have to be dismantled and re-set.

It might be possible, with correct heat treatment in all leaves, that a spring tested 1½ times its working load would not take further adjustment in service provided every leaf were set exactly correct and made smooth on both sides by grinding. The result would be less production. It requires but a few minutes, however, to make it take set without detriment to the spring itself.

Broken leaves are mostly found in old springs reworked many times and, consequently, having greatly reduced flexibility. We have no assurance that leaves in these springs were not overheated before the days of pyrometrical control.

Hammer marks, pitted leaves and corrosion all have a tendency to lessen the life of the steel. Breaking of the top main leaves at slot holes under the clip can be eliminated by annealing the ends after the draw has been made.

In grinding burrs from the edges of slot holes, they should be ground lengthwise. To eliminate breaking of short leaves at the edge of the band, we place one ¼-in. iron plate, the width of the spring and 2 in. shorter than the short leaf, next to the band. The short leaf is not hardened.

Decisions of the Arbitration Committee

(*The Arbitration Committee of the A. R. A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.*)

Responsibility for adjusting lading in closed cars?

On June 12, 1926, B. & O. car No. 184103 and M. K. T car No. 86391, loaded with sheet steel, were delivered to the Pere Marquette by the Baltimore & Ohio. Owing to so many claims arising from damage to sheet steel, caused by its being improperly loaded in accordance with the A. R. A. loading rules, instructions were issued by the Pere Marquette to open cars containing this commodity for inspection. In the case of the two cars in question, this inspection showed that the lading had shifted and had been damaged and that the blocking was loose. Load adjustment orders were issued against the B. & O., charging that road with the cost of adjusting and reblocking the loads. An appeal was taken from the decision of the chief interchange inspector by the Baltimore & Ohio to the interchange committee, which decided that these adjustment orders were erroneously issued and requested that they be returned for cancellation, which was done by the Pere Marquette under protest. Failing to agree, the following question was submitted to the Arbitration Committee for decision, by mutual consent of both parties involved: "Was the Pere Marquette acting within its rights in requesting load adjustment orders to cover shifted steel and loose blocking in closed cars, and was the chief interchange inspector correct in issuing such orders?"

The Arbitration Committee answered the question with the following statement: "The Rules do not contemplate the issuance of adjustment orders for shifted loads in closed cars when such cars do not show evidence, from exterior inspection, that the load has shifted."—*Case No. 1562—Pere Marquette vs. Baltimore & Ohio.*

Responsibility for cleaning air brakes on account of ice in the triple valve

The Chicago Great Western rendered a bill against the Southern Pacific for cleaning the air brakes on S. P. car No. 89174 on November 22, 1926, on account of ice in the triple valve. The S. P. stated that the ice in the triple valve was due to the lack of care on the part of the handling line and that it was not the fault of the owner. The repairing line stated that ice in the triple valve constitutes a condition under Rule 60 for which the owner is responsible.

The Arbitration Committee held the owner responsible under Rule 43.—*Case No. 1563—Southern Pacific vs. Chicago Great Western.*

Cut journal relieves owner of responsibility for a journal exceeding limits of wear

Under date of January 4, 1927, the St. Louis & O'Fallon Railway made the following repairs on authority of a defect card issued by the Terminal Railroad Association of St. Louis for Missouri-Kansas-Texas car No. 24983:

A end	Car jacked	Account repairs
R & L-4	One pair S.H. cast iron wheels....	L-4 vertical flange R-4 secondhand
R & L-4	One S.H. 80-M A.R.A. axle.....	A. R. A. scrap account over length journal
R-4	One 9-in. malleable journal wedge....	Account cut

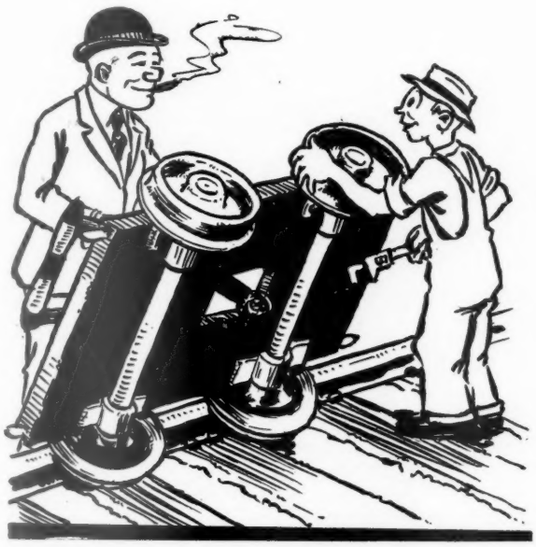
The bill was issued against the carding road for the labor cost of applying the wheels, together with material cost of a journal wedge, journal brass, journal box bolts, etc. A bill was also issued against the owner for the value of the wheels and axle applied, less credit for one second-hand wheel, one scrap wheel and one scrap axle removed. Upon receipt of the bill by the owner, exception was taken to the charge of $12.90 for the axle applied. The repair card was returned to the repairing road with the request that the charge be cancelled inasmuch as the wheels were exchanged on account of a cut journal, which is not an owner's defect as per A. R. A. Rule 86, interpretation No. 5, even though the journal was over length. The repairing road declined to cancel the charge, claiming that the car owner was responsible as the actual length of the journal on the axle removed was 9½ in., which is beyond the limits of wear shown for such an axle in A.R.A. Rule 86.

The Arbitration Committee, in rendering its decision, stated that "The contention of the Missouri-Kansas-Texas Lines is sustained. The responsibility of the handling line for cut journal relieves the owner of responsibility for a journal exceeding the limits of wear on the same axle."—*Case No. 1564—Missouri-Kansas-Texas vs. St. Louis & O'Fallon Railway.*

Disorganizing the shop*

Young Chipps, self-appointed efficiency man, shows the old hands some new tricks of the trade and ties down a job for himself

HIGHBALL SCOTT breathed a sigh of relief as he studied the calendar. "Monday, a week, is Labor Day," mused Highball. "After Labor Day school opens; family reunions, picnics, vacations, and county fairs over, this place will again function as per normal manner. Our shop team will trim the shirts off the town aggregation Labor Day. Will be a ball game worth while. Professor Jackson might get a different slant of railroad inertia if he once saw Jerry Chipps fan out a row of the town boys. I am going to ask Babbitt and Tom James down for the week end. They may do as they like about bringing Prof. Jackson. I believe it would do those two old timers a world of good to watch the shop team perform on the diamond."



Chipps takes a hand at the push car

So it came about that Labor Day found Bill Babbitt, ex-supplyman, now proprietor of Evergreen Nursery Farms, and Tom James of the Commercial Engineering Company, the guests of their friend Highball Scott, master mechanic of the Carbon Valley Railroad. To presume that these three characters could be together without talking shop would be a grievous error. Early Monday morning, Highball and his two friends took a walk down to the shops to see, as Highball expressed it, whether anyone had stolen the place over night. Stogies and pipes steaming properly, shop talk was soon the order of business. "Highball" said Tom James, "did you ever put an investigator to inquiring into your shop problems? That is, something along the line of the efforts of Bill Babbitt, Jr., whom Bill here calls his Farm Engineer."

"No, I did not find it necessary," replied Highball. "I have a young fellow here who, without knowing it, has startled me with an endless line of problems. To begin with I will tell you how it all came about.

"Old Jack Chipps, who takes care of the cab wood work, has a boy who is going to engineering school. Young Jerry usually tries to get work at home here during his vacations. Last summer he worked in the machine shop. He is a likable sort of boy and certainly is of an inquiring turn of mind. He also has an observant disposition, viewing effects and then seeking causes.

Highball hires a youngster

"This spring, after the boy was out of school, he came down and asked me for a job. I did not have anything for him except a cleaners job, which he told me suited him fine. Said he was looking for work durmg his vacation and he was not at all proud about what he did. I told the lad, as he seemed so willing to work, to keep his eyes open while he was about the shop and if he could pick up any information that would benefit him in his school work, he was welcome to it, but that I expected a full day's work, from him each day he was on the job.

"Well, he took hold of the work first class. As I was passing him one day I paused to ask him how he was getting along, and told him if there were any questions about shop work that he saw fit to ask anyone, not to hesitate to do so. The young fellow thanked me and, really, it made me feel good. He is a good deal like old Jack, his father; has a straightforward, direct way about him that appeals to you; also goes about his work as if he meant business and liked the work.

The push-car wheels don't track

"Well, one day shortly after our fishing trip and visit at Bill's Farm, I saw the young fellow have a four-wheel push truck blocked up while he was tinkering with the bearings. The truck, apparently, had been recently overhauled, which caused me to inquire what business he had doing any work on the truck. The boy looked rather embarrassed, but told me that he was trying to make the truck run easier. I wanted to know how he was going to make the truck run easier, and he told me that it would push a short distance on the rails in either direction with little effort, but then the flanges of two of the wheels would rub the rail. He said the truck pushed hard, like when you push a truck around a curve. He found, after investigation, that the axle bearings of the truck were somewhat closer together at one side of the truck than on the other side. He had his work all caught up and was trying to re-locate the bearings in such a manner as to keep the wheels of the truck in line. I saw no harm in that and left him alone.

"In passing his way a few days later, I asked him how the truck worked, and he told me a whole lot better. He showed me how far he had moved the bearings, and also showed me that the truck would run back and forth on the track without crowding either rail.

The idea spreads

"As I was coming from lunch shortly before whistle time the next day, I came through by the tender truck

* The fourth of a series of stories by a railroad man who was once a peddler.

repair gang and overheard this young hopeful arguing with Billy Bolster, the gang boss, about the cause of worn flanges on tender wheels. Billy maintained that the flanges on one side of the tender truck might wear thin on account of the engine running around curves. Jerry argued that if such were the case the wheels on both sides of the truck should wear alike, as ordinarily the engine traveled east on one trip and west on the other. The young fellow saw me and at once referred the question to me for decision. I was rather non-committal, but I commenced to do some serious thinking.

"I had Bolster measure a couple of old arch bar type trucks which showed plenty of flange wear on the right wheels and no wear on the left. The axles were not parallel. Well, one thing brings on another, and next I discover through investigation that the wheel shop is not tapping wheels as carefully as they should in mounting, and that in cases where we found truck frames practically square, we might find a wheel on one of the axles slightly larger than the mate, and with the smallest wheel showing the greater amount of flange wear. I would hate to think how much these conditions are costing the Carbon Valley annually in wheel replacements, and wonder how many other railroads are having more or less the same condition.

"Now remember, what this kid brought to my attention through his push-truck activities and his argument with Bolster were nothing new. We three all know that wheels of different diameters mounted on the same axles will not run properly, but will always crowd in the direction of the small wheel. We also know that if two axles are not parallel that the vehicle tends to travel in a curved path. The situation is this; While I have known these things I never realized that they applied in my own particular case. I never seriously considered the real cause of wheels being removed on account of one wheel being flange worn while the companion wheel was still good for a long period of service.

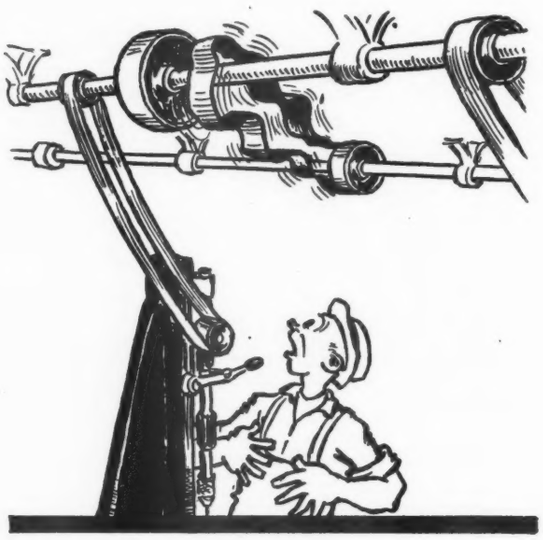
"More than that, watching this youngster's experience with his push truck, leads me to believe that more careful attention to the conditions which I have described, would materially increase the ton-miles now secured from a given amount of fuel."

A lesson in keeping belts on

"Well, that was only a starter. A few days after the argument between young Chipps and Bolster, we needed a fellow on the machine side for a few days to run a drill press. Young Chipps, on account of his past experience, was sent to the job. Now, as you look out from this window, you will notice a second shaft parallel with the line shaft, which drives the blacksmith shop fans, as well as a flue rattler and some other belt-driven tools in the boiler shop. When all the tools driven from that shaft are operated at the same time, the belt sometimes slips off the pulley and causes delays. Also, the operator at this particular drill press gets a generous shower of dust from the beams.

"One day, when all the tools were working, this belt gave an unusual amount of trouble. I learned subsequently that the youngster had helped the belt man twice that morning to replace the belt on the pulleys. The last time he helped he expressed himself rather forcibly that 'it was a shame, for all the cost involved, to have the whole shop shut down three or four times a day while a belt was being put on.' A nearby machinist overheard him and promptly advised the young man that it was wrong for a youth of his experience to criticise conditions that had existed in a shop for years, and that were not complained of by men who had worked before Chipps was born. Chipps told the machinist that he did not care a hoot how long the belt drive was in operation—that it was not right. The foreman appeared about this time and listened in on the wrangle. He asks Chipps what Chipps would do to overcome the condition if Chipps were foreman of the shop. Chipps told the foreman that he would increase the diameter of the two pulleys on shafts. The foreman, of course, wants to know what good that will do. Chipps says the belt will run more feet per minute and do more work.

"The boss comes back at him by telling him that he does not want to change the speed of the shafts. Chipps says that he does not intend that he should. He also tells him that the present pulley is pretty badly worn and will need renewing before a great while anyhow. The boss figures he can put on a wider belt. He asks me about the matter. I look at the belt and see that it has been in service only a short time, I also look back over our past requisitions and find that a belt in that particular job is rather short lived. The boss



Chipps again disturbs the complacency of the shop

does not believe there is any solution to the trouble, except a wider belt; does not consider the youngster's suggestion of increased speed worthy of consideration. Well, while I am looking at the belt I notice that the kid is itching to spring something, so I step over to the drill press and ask him if he has figured any problems in belt drives while he was in school. He tells me that he does not know much about belt drives, but he does know that if that belt runs more feet per minute it will deliver more work. He clinches his argument by stating that if such were not the case you would not need pulleys, and could perform the work by driving the belt right from the shaft. He also submits, as proof, the evidence that his drill press will pull a ¾-in. drill readily when the belt is on the large cone, but will slow down noticeably driving a ⅜-in. drill on the small cone. The result was we had two new pulleys put on the shafts, using the same belt by splicing in a short section, and although that was several weeks ago the belt has not slipped off the pulleys since the change was made.

"Here is the same situation again. We all know that belt running at a high velocity does work almost in proportion to its velocity. On the other hand, that drive to the second shaft has been as it was ever since I worked for this company, and I always accepted the condition as a matter of course and something that we just had to put up with. Along comes a school boy, who, as Tom James says, does not know enough about shop work to distinguish between what we consider right or wrong. By starting an argument he brings up something of importance. Now, the question in my mind is, how many more hundred feet of belting in this

Chipps cleans up the cleaner's shanty

shop is working only half time every day of its life. We feel that in years to come belt drive machines will probably be few and far between. On the other hand we have got some tools in here which are belt-driven and it will be a long while, if ever, before they are motorized. So that is another job that this youngster has wished on me."

Why do drills break?

"The next batch of trouble this active fellow starts is at the tool crib. It seems that the boss gave him an order of several hundred pins to be drilled for cotter holes. He goes industriously about his job and is back to the foreman in few minutes for another drill. The boss, realizing that a man might have hard luck, told him to go to the tool crib and get two drills. Young Chipps does this, but in less than an hour is back to the boss and wants more drills. Now a turning side foreman will run short of good nature just as fast as any other human, so he asks Chipps how in the name of all that is gathered together under a machine shop line shaft, does he expect to earn anything that day when his expense for drills is running up faster than his wages. Chipps says he is sorry that he breaks the drills, but that if he is furnished with poor drills, he does not see how he can help drill breakage. The foreman immediately rises on his hind legs and charges the tool room demanding what kind of a joke they are playing on the boy. Of course, the tool crib man knows nothing of the cause of breakage, and only answer he gives is that he is giving out the drills regularly furnished. The broken drills are submitted as evidence and found to be the same as drills we have been using for a long time. They are of a standard make and they are good tools. The foreman now directs his indignation towards the boy and asks why he calls the drills inferior. All the satisfaction he can get from Chipps is that the drills do not stand up to the job. Chipps says, as the foreman tells me, 'I put each pin in the fixture and keep plenty of cutting compound on the drill while it is working. Beyond that I do not know what more I can do'. Well, the foreman goes down to the drill press and watches the kid drill a few pins. When the self feed is engaged the feed handle spins round like a whirligig, the boss promptly takes a hand, stops the procedure, and asks the youngster if he has no judgment at all. Chipps innocently asks what is wrong, whereupon the boss takes him in hand and informs him that the amount of feed per revolution that he is using would be satisfactory for a 1¼-in. drill, but all wrong for a ¼-in. size.

"Well, the young fellow says that he cannot see why the feed is wrong. He does know that he is running the drill press as fast as it will run. Then he shows the boss a clipping out of a mechanical magazine which gives some of the drilling operations at an automobile plant. He explains to the boss that to drill a hole ¼-in. in diameter in a given distance in O.H. steel should only take so many seconds. When he started the job he found that he was drilling at only about one-third of the rate shown on the operation sheet. As he explained before, the drill was running as fast as he could run it, so he steps the feed up one notch. Still too slow. Steps it up another notch. Still too slow. Finally up to the place where the boss finds it, and yet he mourns to the boss that with those drills he simply cannot put a hole through as quick as is shown on the operation sheet. The boss asks him how fast the drill should run according to this operation sheet, but the young hopeful is unable to answer. He still sticks to his original text, that he is running the machine as fast as it will run, but is not getting out as many inches of drilling per hour as is done in the automobile plant. Therefore, the drills appear to him to be of inferior quality. Otherwise, why don't they stand up?

"The tool room foreman finally interests himself in the case and explains to the boy and to the machine shop foreman that the drill spindle does not run fast enough; that the boy has discovered there will be no drill breakage with half the amount of feed that he has last used. Well, one thing brings up another; they finally put an indicator on the drill spindle and find out that it is turning about 60 per cent of the normal speed for ¼ drills. The machine shop foreman is not going to overlook a bet when a man crabs for means for producing more work from a machine, so he at once gets busy and orders a new pulley to put on the line shaft for the drill press drive. The outcome of the adventure is that we do secure from this drill press a mighty creditable performance record, and that without any noticeable drill breakage.

"This gives me another question to work out. Are all of our tools being driven at the speed most efficient for the work that is assigned to them? I am not sure that this drill press can be run sufficiently slow to handle the largest diameter drill that the machine is intended to drive. The foreman, however, says that that question does not worry him because he will put the bigger holes over on the bigger machines. Possibly he is all right on that, but the fact that this kid chanced upon the report of an operation in an automo-

bile plant has jolted our drill press practices clear down to the foundations.

The magic of a little whitewash

"Not satisfied with creating several full size disturbances in the shop, this active candidate real soon starts another. Seems, while he was working at the drill press one day, he spied through the open door of a cabinet-leg machine the white interior of the tool cupboard in the cabinet leg. Young America promptly makes note of the fact that from where he sits at the drill press, he can see every tool lying on the shelves in that cabinet, yet when he looks for wrenches, bolts, or washers in the steel locker by his drill press, he has to grope quite considerable before he locates the object of his search. Directly he goes over to the rod bench and borrows a can of whitewash. He whitewashes the inside of the cupboard. Fine! Now he can look into that locker and readily see anything, as the legal phrase states, 'therein contained.'

"The cleaning job in the meantime has gotten a little ahead of the cleaner gang, while the machine shop boss is able to spare Chipps for a few days. On account of fire hazards in the cleaner's shanty where they handle small parts, I tell them one day to keep all material cleaned out from the walls, and that there should be no accumulation of any kind in these places. Chipps falls to work cheerfully, moving everything away from the wall, scrapes out several months' accumulation of grease and dirt from the corners and then, to cap the climax, gets the whitewash brush and pail and paints a strip a foot wide around the floor and two feet up the side walls of the shanty. After he has this job done a stray bed bug from the caboose track could not cross that whitewash dead line without placing himself in a high state of visibility.

"Pickles Lemon, our genial roundhouse foreman, is over to the cleaner's shanty one day in search of an odd spring hanger which we do not happen to have in stock at this particular time. He saw the whitewash job. Whether he ever got the hanger or not, I never heard, but we do know that that whitewash border registered a bulls-eye with Pickles.

"He positively abhors litter or trash in a roundhouse. He will stop in the middle of a conversation and run three stalls to pick up a scrap half-inch bolt that the floor sweeper has overlooked.

"Pickles at once commences range finding practice. He throws a cotter on the white mark on the floor, backs out several feet and squints at it. Next he lays a penny on the floor and tests his vision on that. A small scrap of dirty waste is tried the same way. Next, Pickles calls me on the phone, 'Boss,' he says, 'can you meet me, right away, at the cleaner's shanty? It's important.'

"I go out and from a distance see Pickles standing outside of the door of the shanty and noting the effect. When I arrive he tells me what it is all about. He wants the brick wall of the roundhouse white washed four feet high and a strip two feet wide on the floor, and he won't be happy until he gets it. I tell him that we have no money to spend whitewashing roundhouse floors and walls. He tells me that if the job costs the company one nickel—and that if the cost can be located—he will pay every bit out of his own pocket. I tell him to go to it.

"He putters away at a vise near his desk and rigs up a spray. Next he mixes various concoctions of salt, lime, carbide refuse, and goodness knows what else. Before he is through he adds a little bluing, which he assures me makes the whitewash still whiter. Well, at any rate, Pickles gets the roundhouse whitewashed, and I think my mind will be at rest for a while.

"Not so, however. Along comes our friend the tool room foreman. Pickles talks to him and brags that he can see a wrench lying on the floor in front of a locomotive 12 stalls away. Brags how his place looks presentable. Hints that the tool room is a back number.

"Well, the tool room foreman gives me no rest until I agree to let him brighten up things a bit in the tool room. He says, of course, that the tool crib man will do the job at odd times, but I note that after he gets started, he is borrowing a fellow here and there for a few hours trying to put it across.

"Now the machine-shop foreman comes forward and wants to know how it comes that everyone around the place can get something except him. When I ask him what in particular everyone else has but him, he tells me that I have had the roundhouse and the tool room whitewashed, and yet his shop, which is the darkest of the lot, has to remain as it is. He seems to feel rather hurt over the whole thing.

"I still have his case to consider. I do not know where the thing is going to stop. If that infernal kid should chance to discover that a piece of step-tread rubber will make a non-skid floor, the chances are, unless he is promptly stopped, that the safety committee may want the whole shop floored with rubber matting. All of which goes to show what may be the ending of a small beginning.

"Now, mind you, there is nothing new in the idea of whitening an interior in order to improve light conditions. But one would hardly think that one of the cleaners, plus an open door, plus a white locker, would equal a request from the machine shop foreman to whitewash hundreds of yards of machine-shop wall, together with all kinds of overhead beams and countershaft timbers.

"Now, understand, this young fellow has some redeeming qualities. Possibly I should modify my statements. I do not mean that his activities have been entirely undesirable, but they have kept me busy.

"Lunch times and evenings, once he got himself established here, he commences an agitation among the fellows to organize a baseball team. He is a mighty good pitcher himself and the results of his activities are that the Carbon Valley shop team stands well to the front of the local league. This afternoon if I don't show you fellows one peach of a ball game you may call me a hum-back liar.

"On the other hand if I had two or three more kindergarten products as active as that fellow, one of two things would be inevitable. Either the Carbon Valley shops, in a short time, would be the most modern railroad shop in the country, or there would be a strange face in the Foolish House registering under the name of Highball Scott."

There's nothing new in Chipps' discoveries

Tom James winked at Bill Babbitt as he lit a fresh stogie and listened for Highball to continue. Highball sat meditating, making no remark. James commenced. "As I see it, Highball, you have unconsciously followed the example of Babbitt somewhat in the way I suggested when we were at Evergreen Farms."

"What do you mean?" asked Highball.

"Why just as I say," replied James. "You did not engage young Chipps as a plant engineer, nor as that much overrated person, an efficiency expert'. He is not a production man, neither is he a personnel director,

yet unconsciously the youngster has touched on all these subjects and created a healthy reaction in your plant. What do you say, Bill?"

"Well," replied Bill, "I have been recalling history a little, while Highball was talking, and in my experiences as a supply man, I have seen some things happen very much like what Highball has mentioned. His truck-wheel story reminds me of a shop incident I once witnessed. These fellows had endless trouble with engine truck wheels wearing sharp at one side. Some engines would sharpen on the right side, some on the left, but it was not usual to find a pair of wheels showing equal wear. While I was in the shops one day the superintendent asked me if I ever had any experience in this line. I had not, but was willing to aid him in any way I could, as all good supply men are willing to do.

"Their wheels were mostly all cast iron centers fitted with steel tires. In the course of our conversation it developed that the few cast iron engine truck wheels used did not give nearly as much trouble sharpening on one side as was experienced with the steel-tired wheels. That was at least a clue. We taped some new pairs of mounted cast iron wheels and found that the wheel shop was very careful about mating wheels accurately. We measured some demounted tires and found that they were shipped in pairs of uniform diameter.

"In examining some re-turned steel-tired engine truck wheels it occurred to me that one wheel showed a bearing on the rail farther from the flange than the other wheel showed. As the wheels had been rolled back and forth on the shop track, more or less dirt and grease would accumulate on the treads. That established another clue.

"After investigation, they located the trouble. The wheel-lathe operator was starting with his cuts uniform in diameter at the outer edges of the wheels. Once his diameters were established and roughed the treads and flanges were worked to contours by forming tools, and again checked at the outer edge of the tread. We found that the treads of the wheels were of the same diameter at the outer edges, but were of different diameters at the root of the flange. Further investigation developed that the mark by which he located his slide rest to the proper taper in turning engine-truck wheels was not placed alike on the two slide rests of the machine. Therefore, while the outer edges of each pair of wheels were of equal diameter, the diameter of the measuring line of one wheel was always less than the diameter of the mate. They had already checked engine-truck alinement, looked for improperly located engine-truck center pin guides, and all other imaginable locomotive difficulties, but had overlooked what the wrong location of a little line at an important place upon a machine tool would mean in locomotive service. Your truck condition is something along the same line and yet the condition exists for years unless forcibly brought to some-one's attention.

"Your high speed belt has a parallel in a planer drive. Did you ever notice a good husky belt-driven planer tearing off a generous slice of metal with a tool in each of the cross-rail heads, and possibly in one of the side heads, and with the whole thing driven by a 3-in. belt running like all possessed"?

Disjointed evolution

"That drill press of yours, I'll bet dollars to doughnuts, was driven by the same pulley that was placed there when the machine was installed. I have seen similar conditions in a good many railroad shops.

"You know that at the advent of high-speed steel all shops did not turn over-night from carbon-steel tools to high-speed-steel tools. Production shops, such as automobile shops for example, have come into existence since the advent of high-speed-steel. Special machines have been developed for special operations. The highest possible amount of metal to be removed by a cutter in a given time has been determined, and the whole design and set-up of the machine has been based on the production qualities of that particular cutter. Now the railroad shop started in with a few sizes of high-speed drills, a few bars of high-speed steel for lathes and other machine tools. Probably the wheel lathe, axle lathe and car-wheel borer were the only machines where a radical change was made. Once the possible output of high-speed steel was discovered, these machines were pushed up to the capacity of high-speed cutters or, in many cases, the old machines were retired and machines designed to drive high-speed cutters were installed in their places.

"With the drill press, lathes, and planers, the story was different. You had a few high-speed drills, but a greater number of carbon drills. No one could see their way clear to scrap thousands of dollars worth of perfectly good equipment. Therefore, the change was gradual. The speed of the machines was not changed beyond the change made by stepping up the cone belt. In many cases countershaft speeds were not changed. In due course of time the carbon drills passed pretty well out of the picture, but has not the case of young Chipps shown you that the carbon drill speed of the drill press spindle still remains?"

"I suppose that's true," said Highball.

"Your experience with lighting a dark interior is simply one of the earlier stages of illumination engineering. Let me assure you, Highball, that the big plant of the present day is not lighting by haphazard methods. The space to be illuminated is carefully calculated; the amount of candle power for night illumination is determined, and each and every light so placed as to give the best distributed illumination. This avoids eye strain and discomfort on the part of the workers and pays regular generous dividends in increased output. Your boy was uncomfortable because he is an eager-minded fellow, to have to grope in a dark locker to find the right wrench or bolt to do his work on the machine. He only did on a small scale what considerations of economy have caused big industries to do on a large scale. His idea is nothing more nor less than the germ of a plan to secure better plant lighting."

The value of a fresh viewpoint

"I think you are absolutely right, Bill," said Tom, "and I believe if Highball ties in a few more scattered leads like those he has picked up, he will have a railroad shop that will run on a par with Evergreen Nursery Farms.

"That baseball nine idea is good stuff too. You know there are many firms that would pay real money to get the pull-together spirit in an organization that can be fostered in no better manner than by the organization of athletic teams. My advice to you, Highball, is that when you get an energetic youngster in your plant just let him stir up things like this boy has done. You are going to get big benefits in the long run from his activities. Fact is, familiarity breeds contempt. Your mind is too busy on the bigger things to notice the minor leaks which will cause more waste than the full flow from the spigot. Each of you department heads

has his own particular duties and there is always a possibility for a man's mind to become centered on output as the main channel and to overlook some mighty important tributaries which, if properly controlled, will keep the main channel at full flow.

"I believe before you are done you are going to have in your midst as a permanent fixture, some active fellow working along the same lines as young Chipps."

"What I am going to have," said Highball, "is that identical youngster, once he is out of college. I am going to unload a lot of those annoying problems onto that young fellow and look to him for solutions. If he can do as well as he has shown in some of his activities, he will get the solutions without calling on me for help. Finally, if I can ever get that fellow on these premises and get him lined up on the job, the man who pries him loose and drags him into the supply field or contracting shop, will do it over the lifeless remains of yours truly. Now let's go up to the house, eat a bite, and go see the tug-of-war, the races, and, last but not least, Jerry Chipps' team play some first-class baseball."

"Sounds right," said Bill Babbitt.

The Elimination of Federal Defects*

Prevention is the first requisite—Thorough education and co-operation of employees is necessary

By A. G. Pack

Chief inspector, Bureau of Locomotive Inspection, Interstate Commerce Commission

THE better maintenance of locomotives has contributed largely to the improved performance of the railroads. Because of the interest of the members of this association now being displayed in eliminating federal defects on locomotives, it is evident that it is your intention to continue to take a full part in the work that is ahead of us.

"What constitutes a federal defect on a locomotive"? The statute makes it unlawful for any carrier to use or permit to be used on its line, any locomotive unless said locomotive, its boiler, tender, and all parts and appurtenances thereof are in proper condition and safe to operate without unnecessary peril to life or limb, and unless said locomotive, its boiler, tender, and all parts and appurtenances thereof have been inspected from time to time and are able to withstand such test or tests as may be prescribed in the rules and regulations therein provided for.

What is "proper condition and safe to operate without unnecessary peril to life or limb"? When this statute was enacted it was evidently recognized that there existed a certain peril in locomotive operation which could not be forseen or entirely avoided, but the requirements "proper condition and safe to operate without unnecessary peril to life or limb" seem to make it perfectly clear that everything connected with the locomotive must be made as safe as it is humanly possible to make it, and that all defects which in any way imperil safety that can be discovered by a thorough and careful inspection must be remedied before the locomotive is again used.

Interpretations of the law

This applies whether or not the rules and regulations established and approved by the Interstate Commerce Commission expressly prohibit the use of the locomotive while thus defective.

Various federal courts, in construing the Boiler Inspection act as amended and other analogous acts, have said in various cases, from which the following are quoted and citations given:

The power of Congress over commerce authorizes all appropriate legislation for the protection or advancement of either interstate or foreign commerce, and such legislation as will insure safety in the movement of such commerce, and such legislation may consist in prescribing the form and size of the vehicle employed, in subjecting it to inspection and license in order to insure proper construction and equipment.—*The Daniel Ball, 77 U. S. 557; McCall v. California 136 U. S. 104.*

The authority of Congress extends to every part of interstate commerce and to every instrumentality or agency by which it is carried on; and the full control by Congress of the subjects committed to its regulation is not to be denied or thwarted by the intermingling of interstate and intrastate operations.—*Minnesota Rate Case, 230 U. S. 352.*

The power delegated under the act (Locomotive Inspection) extends to the design, the construction, and the material of every part of the locomotive and tender and all appurtenances. —*Napier et al. v. Atlantic Coast Line R. R. Co. 272 U. S. 605.*

The Safety Appliance Acts and the Employers' Liability Act are in *pari materia* with the Boiler Inspection Act as amended, and decisions under the former acts are applicable to the latter. —*Ft. Worth & D. C. Ry. Co. v. Jones, 294 F. 858 N. C. R. R. Co. v. Zachary, 233 U. S. 360.*

Where a statute commands that an act be done or omitted which in the absence of such statute might have been done or omitted without culpability, ignorance of the fact or state of things contemplated by the statute, it seems will not excuse its violation.—*C. B. & Q. Ry. Co. v. United States, 220 U. S. 559.*

Where permission is granted another to use the carrier's line, actual knowledge of the defective condition of the car when hauled pursuant to such permission, is not essential. It is the absolute duty of carriers to exclude defective equipment for use on their lines, irrespective of actual knowledge of the defects, or the exercise of reasonable care.—*United States v. Southern Ry. Co., 285 F. 766.*

When Congress forbade the hauling, or permitting to be hauled of any such defective equipment, it very evidently intended to exclude any permissive use in derogation of the danger sought to be guarded against, not only as to employees, but to the public, and made the carrier permitting such use responsible therefor.—*United States v. Northwestern R. R. Co., 235 F. 969.*

It is urged that the words "require" or "permit" imply consent or knowledge on the part of the employer, and this is perhaps their common significance; but the word "permit" also means a failure to prohibit by one who has the power and authority to do so, and in my opinion the term is here used in the latter sense.—*United States v. O. W. R. & N. Co., 213 F. 688.*

A car fully loaded and on the track ready to be started as a part of a train on an interstate highway, and requiring only the touch of the engineer to start it on its journey, is used or in use, within the meaning of the statute.—*United States v. St. Louis S. W. Ry., 184 F. 28 (C. C. A. 5th Cir.)*

Each use of a locomotive without conforming to the law or rules established thereunder constitutes a violation.—*United States v. Southern Ry. Co. 1 F. (2nd) 487; United States v. Long Island R. R. Co., 4 F. (2nd) 750.*

* An address delivered before the International Railway General Foremen's Association during the convention at the Hotel Sherman, Chicago, September 18, 1928.

Use either in switch yard or in actual road service upon the main line by a carrier engaged in interstate commerce, is a violation of the statute.—*Delk v. St. Louis—S. F. Ry. Co. 220 U. S. 580; United States v. Pere Marquette Ry. Co. 211 F. 220.*

It prohibits the use of an engine out of condition, and it can make no difference when that unfit condition arises. The statute does not limit the duty as to condition and the time of starting.—*Kilburn v. Chicago, Milwaukee & St. Paul Ry. Co. 232 S. W. 101-7.*

The act is applicable to all vehicles (locomotives) on any railroad which is a highway of interstate commerce, whether the vehicles themselves are engaged in interstate commerce or not. The safety to be secured by the act is the safety of persons transported in interstate commerce and of those who are employed in such transportation, no matter what may be the source of the danger which threatens it.—*B. & O. R. R. Co. v. Hooven, 297 F. 919, (C. C. A. 6th Cir.)*

A bell ringer is a "part" or an "appurtenance" of a "locomotive or tender" within the meaning of the Boiler Inspection Act.

If a locomotive is equipped with an automatic bell ringer which is out of repair, a hand-operated bell ringer cannot be accepted as a substitute under the Boiler Inspection Act, an act to promote the safety of employees.—*Hines v. Smith, 275 F. 766.*

"Secure steps" as required by the Safety Appliance Statute mean steps which furnish secure footing for employees having to use them. This is made more evident by the broad language of the Boiler Inspection Act, which prohibits carriers from using a locomotive unless it and all its parts are in "proper condition and safe to operate" in the service to which they are put.—*Davis v. Reynolds, 280 F. 363, Certiorari denied. 258 U. S. 627, 42 Sup. Ct. Rep. 393, 66 L. Ed. 798.*

The Boiler Inspection Act in effect makes the employer an insurer of the safety of the place in which the employee works, and of the appliances with which he works.—*Lehigh Valley R. R. Co. v. Beltz, 10 F. (2d) 74.*

The Boiler Inspection Act as amended imposes on carriers of interstate commerce an absolute duty to keep their locomotives free from defects and absolutely safe to operate; "absolute duty" means one not subject to any limitation or condition, positive and not dependent, or qualified by any consideration whatever.—*Lehigh Valley R. R. Co. v. Beltz, 10 F. (2d) 74. Lehigh Valley R. R. Co. v. Huben, 10 F. (2d) 78.*

While the Interstate Commerce Commission is authorized to make rules and orders in furtherance of the enforcement of this law, the absence of rules covering defective construction or condition within the meaning of Section 2 of the Boiler Inspection Act by no means relieves the carrier from complying with the provisions of that section.—*Baltimore & Ohio R. R. Co. v. Groeger, 288, F. 321.*

Legislation of this character having established the primary standard, the executive duty of carrying out the policy of the statute may devolve upon the administrative tribunal.—*Minneapolis R. R. Co. v. State, 134, U. S. 467; Illinois Central R. R. Co. v. Williams, 242 U. S. 462.*

I might quote indefinitely from Federal Court decisions in establishing the requirements of the law and the responsibility of the railroads of which you are agents, but I believe enough has been said to establish the responsibility which rests upon you as general foremen in direct charge of construction, inspection, and repair as required by the law, and of your duties to your employers.

Duties of administering the law

What are the duties of those in charge of the administration and enforcement of the Locomotive Inspection Law? The law requires that there shall be appointed by the President, by and with the advice and consent of the Senate, a chief inspector and two assistant chief inspectors, who shall have general superintendence of the inspectors provided for, direct them in the duties imposed upon them and see that the requirements of the Act and the rules, regulations and instructions made or given thereunder are observed by common carriers subject thereto, who shall have practical knowledge of the construction and repairing of locomotives and tenders, with ability to systematize and carry into effect the provisions of the law relating to the inspection and maintenance of locomotives. The law further provides for the appointment of sixty-five district inspectors whose duty it is to make such personal inspection of locomotives under their care from time to time as may be necessary fully to carry out the provisions of the law. Their first duty is to see that carriers make inspections in accordance with the rules and regulations established or approved by the Interstate Commerce Commission, and that the carriers repair the defects which such inspections disclose before the locomotive or appurtenances pertaining thereto are again put into use.

It may be observed from the requirements of the law that your duties are absolute and continuing and may not be evaded. The mere fact that a federal inspector has not found fault with a method of inspection or repair does not relieve the carrier from the responsibility placed upon it.

Eliminating defects

Many major factors, all of which are important, are concerned in the elimination or reduction of defects on locomotives. The highest degree of success can be attained only through the cooperation of the designer, the builder, the industries that furnish materials and those that furnish the various appurtenances and appliances which make our modern locomotives so efficient, and the carriers' maintenance forces in the back shop and enginehouse. However, the results required of the maintenance forces demand continuous, never-ceasing effort.

The thoroughness with which repairs are made may mean the difference between success or failure of those engaged in keeping the locomotives in proper condition. In order that the back shop may not be handicapped in making thorough and efficient repairs in a reasonable time, it is essential that as much advance information as possible be made available as to the repairs required.

Advance information will enable those in charge of the work to have on hand all necessary material so as to eliminate the necessity of again using parts that should be replaced, in the effort to turn the locomotive out on schedule time and contribute to the orderly movement of the work through the shop. While this statement may appear to savor of shop efficiency rather than a step in the elimination of defects, I assure you that it has a vital bearing, because all of you know that there is a temptation and a tendancy to get the locomotive through the shop on schedule time, even to the neglect of proper and thorough repairs and renewals.

There is nothing truer than that old adage: "Like master like man." Workmen will naturally be no more thorough than their supervisors. In other words, the attitude of the highest is reflected to the lowest. Therefore, lack of thoroughness in what may sometimes appear to those in charge as a justifiable emergency, opens wide the door to repetition of the same practice by others and will react.

Prevention the first requisite

Prevention is the first requisite in the orderly process of reduction or elimination of defects, and, assuming that the builder and associated agencies have done their part, this must start in the back shop. When locomotives are shopped for general repairs, all parts should be thoroughly cleaned and inspected and all repairs needed to restore wear and place parts in good condi-

tion should be properly applied, in order that the locomotive may re-enter service in such condition that major renewals will not be needed during its expected term of service between shoppings. This statement holds true regardless of whether the locomotive may or may not be of the most modern type. So long as a locomotive is to be continued in use, it should be turned out after each general repair with unimpaired ability to handle its full tonnage on schedule time.

After a locomotive has been placed in service, we must be ever vigilant in the discovery of all conditions that indicate a defect in the process of development, and if this is carried out conscientiously and thoroughly, and proper repairs made at the proper time, we will have practically eliminated "federal defects", because we will have prevented many defects from developing to the point of failure. If engine failures or train delays must be had, the proper place to have them is at the terminal, where safe and economical repairs may be made.

Rule 104 of the Rules and Instructions for Inspection and Testing of Steam Locomotives and Tenders and Rule 203 of the Rules and Instructions for Inspection and Testing of Locomotives other than Steam, which are identical in wording and intent, require that

> Each locomotive and tender shall be inspected after each trip, or day's work, and the defects found reported on an approved form to the proper representative of the company. This form shall show the name of the railroad, the initials and number of the locomotive, the place, date, and time of the inspection, the defects found, and the signature of the employee making the inspection. The report shall be approved by the foreman, with proper written explanation made thereon for defects reported which were not repaired before the locomotive is returned to service. The report shall then be filed in the office of the railroad company at the place where the inspection is made.

The trip or daily inspection and report thereof, required by the locomotive inspection law and rules, enables those in charge of running repairs to keep informed of the current condition of each locomotive The value of the inspection reports in the elimination or reduction of defects depends upon the thoroughness of the inspections made, the integrity and clarity of the reports, and the amount of interest displayed by the foreman and others having jurisdiction over repairs. It is not the purpose of the rule to permit locomotives to be returned to service with any defects in violation of the law or any rule or regulation made thereunder.

I may here remind you that the requirements covering the construction, inspection and repair of locomotives and tenders under the law, are the rules and regulations recommended and established by the best known authorities on mechanical matters, such as the Mechanical Division of the American Railroad Association, Locomotive Builders, and standard practices adopted by the railroads prior and subsequent to the enactment of the Locomotive Inspection Law. Therefore, the requirements of the law and the rules and regulations established thereunder are not new and untried theories, but are based on well known and established practices. It is therefore essential that the officer charged with the duty of passing upon inspection reports and necessary repairs have thorough knowledge of the requirements and be endowed with sound judgment in order that all repairs may be made in proper time and place and without unnecessarily withholding the locomotive from service.

Since one of the important features of our job is to do the best we can with the facilities, tools and equipment provided, we must face conditions as we find them without regard to the layout of our terminal or whether it is equipped with the most modern and efficient facilities for expeditious handling of locomotives.

Terminal procedure

It is essential, however, that systematic procedure be adopted in routing a locomotive through the various steps after arrival and that due weight be placed on the necessity for thorough and complete inspection. Upon arrival of a locomotive at a roundhouse or shop terminal, or as soon thereafter as possible, tests should be made for blows, pounds and steam leaks before the boiler pressure is allowed to drop appreciably and all visible parts of the boiler, machinery and tender should be thoroughly inspected and all defects found reported on the required form in an intelligible manner, otherwise you who are in direct charge of maintenance can not be in position to say to the superintendent or dispatcher at what time you can furnish a locomotive, in proper condition and safe to operate, for an important train.

We have now reached the point at which decision must be made as to what repairs shall be made and what repairs, if any, may be deferred. It might seem to some unnecessary to say that the decision should not be based on expediency, but unfortunately we too often find that this is the case. If we are to be successful in eliminating "federal defects," we must not allow a locomotive to leave a terminal with any defect, or condition that is at all likely to cause failure while en route. It is generally conceded that the best results are obtained if we do not permit ourselves to fall into the error of considering small defects as of minor importance. The only safe policy is the full recognition of the fact that a potential accident lurks in the shadow of many apparently insignificant defects. The mere ommission of a cotter key, or failure to spread the key when applied, has too often resulted in serious failure.

Injectors, feedwater heater equipment, water-level indicating levices, brake and signal equipment, lighting equipment, rain control equipment, and other special devices should always be tested and known to be in proper condition before starting on each trip.

The carriers enjoying the greatest success in eliminating defects are those having systematic outbound, as well as systematic inbound inspection.

It is a recognized principle of all successful production methods that thorough inspection of each component part and of the assembled unit is essential to the control of quality, and I have, therefore, emphasized inspection, before and after applying repairs, as a prime requisite in the process of eliminating defects.

Many mechanical officers do not take full advantage of the opportunity afforded by the daily inspection reports to keep informed of the sufficiency and durability of repairs made from trip to trip. We too often find the same defects repeatedly reported, with evidence that repairs had been attempted each time reported. This should be ample warning that the methods of repair were not effective, that progress was not being made in eliminating these defects, and that time and money were being wasted. Comparisons of the items reported on individual locomotives from trip to trip will point out ineffective repair methods, pay big dividends in reduction of defects, greater security, and reduced cost of repairs If it is required that a de-

fective condition should be repeatedly reported, it is evidence that there is something wrong; therefore, the cause should be sought and a permanent remedy applied.

The periodic repair system

Many of the larger railroads have adopted what is commonly termed the periodic repair system. This consists of a thorough repair job at times of monthly or annual inspections required by the law and rules, putting the locomotive on condition to run to the next monthly inspection and repair period with a minimum of mechanical attention.

I am of the opinion that this periodic method of making inspections and repairs is the best system yet devised for putting locomotives in condition so as to obtain the maximum freedom from defects, maximum daily mileage, and maximum reliability in service, at a minimum cost.

Co-operation is the keynote of success; therefore, we should not neglect the personal element, because success in any undertaking depends largely upon human relations. Good will and mutual confidence are paramount. We all do our best work under the stimulus of encouragement and approval of the people for whom we are working. The example set by those in charge goes far in producing success in any undertaking. Leadership, teaching and training, with sincere efforts to advance the legitimate interests and happiness of those whom we supervise, are more essential to success than elaborate organization or modern shop facilities, desirable as these may be.

Locomotive conditions continue to improve

The effect on the condition of locomotives and number of accidents brought about by efforts to eliminate or reduce federal defects by thorough inspection and better and prompt repairs is illustrated by the following tabulation derived from the records of the Bureau of Locomotive Inspection.

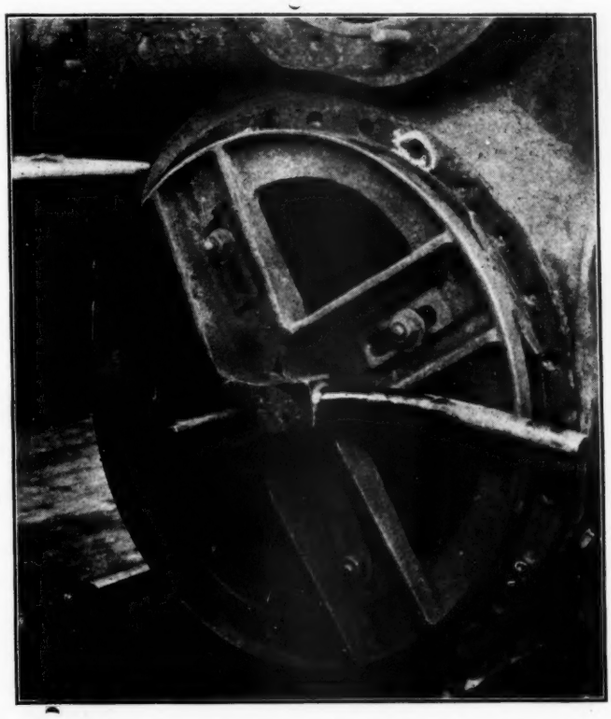
Fiscal year ended June 30	Percentage of locomotives inspected found defective	Number of accidents
1923	65	1348
1924	53	1005
1925	46	690
1926	40	574
1927	31	488
1928	24	418

It will be noted that the percentage of locomotives inspected and found defective decreased from 65 per cent in 1923 to 24 per cent in 1928, and that the number of accidents decreased from 1348 in 1923 to 418 in 1928. Our records show that the number of persons killed as result of the failure of some part or appliance of the locomotive or tender was reduced from 72 in 1923 to 30 in 1928, and that the number of persons injured from the same cause was reduced from 1560 in 1923 to 462 in 1928, or a reduction of 58 per cent in the number of killed and 70 per cent in the number injured.

That further reduction in defective locomotives, together with consequent further reduction in accidents is possible, is evidenced by the fact that the percentage of defective locomotives on a number of large railroads that do not operate under particularly favorable conditions is less than one-half of the general average for all railroads, while many large roads equally, or more favorably situated as to operating conditions exceed the average by material amounts.

Device for facing cylinder head joints

THE device shown in the illustration for facing cylinder head joints can be operated either by hand or by pneumatic motor. It is secured to the cylinder by a long bar which extends through the cylinder and then through a stiff casting at the opposite end. The end of the bar is threaded for an extra heavy nut and



This device for facing and grinding cylinder head joints effected a saving of $14.28 per pair

the facing device is drawn tightly against the joint surface by tightening this nut. The facing device rotates on this bar.

The joint is faced by four files secured to adjustable shoes, as shown in the illustration. The device can be rotated by means of the lever or by slipping the sleeve of a pneumatic motor over the mandrel shown. It formerly required one machinist and a helper from 12 to 16 hours to face and grind one pair of cylinders at an average cost of $17.92. With the method just described, this work can be done at an average cost of $3.64.

THE AVERAGE COST of locomotive fuel charged to operating expenses by Class I railways, excluding switching and terminal companies, in June was $2.55 as compared with $2.63 in the corresponding month of last year, according to the Interstate Commerce Commission's monthly statement of locomotive fuel statistics. These figures include direct freight charges. Excluding freight charges, the average cost was $2.14 as compared with $2.20 in June of last year. For the six months ended with June the railways consumed 56,640,000 tons of coal, at an average cost of $2.56, as compared with $58,793,914 tons, at an average cost of $2.67, in the correspondng period of last year. They also used 1,165,075,886 gallons of fuel oil, at an average cost of 2.56 cents a gallon, making the total cost of coal and fuel oil $172,336,073 for the six months, as compared with $191,063,857 last year.

D. C. Curtis addresses tool men

Purchasing head of the Milwaukee discusses subject of tool buying at Chicago convention

AT the sixteenth annual convention of the American Railway Tool Foremen's Association, held at the Hotel Sherman, Chicago, September 12-14, inclusive, one of the features of the program was an address by D. C. Curtis, chief purchasing officer of the Chicago, Milwaukee, St. Paul & Pacific, who stated that the following are important factors in the economical purchase of railway tools: Standardized commercial designs, better cost analysis by users, less "twelfth hour" ordering, budgeted expenditures and greater purchasing department latitude in bargaining.

In addition to the address by Mr. Curtis, the subject of "Car shop tools" was presented by P. Kass, superintendent of the car department of the Rock Island, and E. H. Ehrman, a member of the American Society of Mechanical Engineers, explained in a brief address how the American Railway Tool Foremen's Association can co-operate with national technical associations in bringing about a greater standardization of many industrial tools now used by the railroads. Committee reports were presented at the convention as follows: "Proper heat treatment of steel," Chairman H. L. Taylor, supervisor of shop machinery and tools, Baltimore & Ohio, Baltimore, Md.; "Standardization of boiler tools," Chairman A. A. Ferguson, supervisor of tools, Missouri Pacific, St. Louis, Mo.; "Jigs and devices for locomotive shops," Chairman W. R. Millican, tool foreman, Missouri-Kansas-Texas, Parsons, Kan.; "Rake and clearance of machine tools," Chairman J. E. Carroll, supervisor of tools, Chesapeake & Ohio, Huntington, W. Va., and "Standardization," Chairman E. J. McKernan, supervisor of tools, Santa Fe, Topeka, Kan.

E. A. Greame (D., L. & W.)
President

Election of officers

At one of the regular sessions, the association elected the following officers to guide its activities during the coming year: President, W. R. Millican, tool foreman, Missouri-Kansas-Texas, Parsons, Kan.; first vice-president, H. P. Jones, supervisor of tools, Oregon Short Line, Pocatello, Idaho; second vice-president, A. A. Ferguson, supervisor of tools, Missouri Pacific, St. Louis, Mo., and third vice-president, H. L. Taylor, supervisor of shop machinery and tools, Baltimore & Ohio, Baltimore, Md. G. G. Macina, Chicago, Milwaukee, St. Paul & Pacific, Chicago, was re-elected secretary-treasurer. One new member was elected to the Executive Committee—W. J. Davidson, tool foreman, Atlantic Coast Line, Waycross, Ga. Other members of the Executive Committee consist of Chairman J. T. Jones, tool foreman, New York Central, Cleveland, Ohio; E. J. McKernan, supervisor of tools, Atchison, Topeka, & Santa Fe, Topeka, Kan.; J. E. Carroll, Supervisor of tools, Chesapeake & Ohio, Huntington, W. Va., and C. A. Shaffer, general supervisor of machinery and tools, Illinois Central, Chicago, Ill.

Mr. Curtis' address

[In this, the first address presented by a railway supply officer to the American Railway Tool Foremen's Association, Mr. Curtis advised against specially-made tools for railroad use when reasonable co-operation among users and makers would add the benefits of mass manufacture to the production of satisfactory equipment for all purposes, and he particularly expressed a desire to see more co-ordination and understanding between those who order tools on a railroad and those obligated to buy them, as a means of cutting tool costs. The more detailed remarks of Mr. Curtis' are presented in part as follows.—EDITOR.]

Individual railway tool rooms do not use sufficient tools to make it profitable for many manufacturers, or even a few competitive manufacturers, to produce special tools. On the other hand, tool users on railroads, with their ingenuity and practical experience and working with the manufacturers, can usually secure commercial designs sufficient to their needs. The tools may then be purchased at a reasonable price, and the benefits of this study by individual tool users extended to others in the railroad field. It pays to discuss the tool problem with the manufacturers, as in many instances they are able to make improvements, both in quality and price, and still furnish a suitable article for the work required.

The tendency in railway tool design is to make tools that will not wear out. This practice is not always sound. A tool should be made so that it will produce a profit for its user. It should be made to last only a reasonable length of time and pay a dividend in that time. Some of the most successful users of tools, particularly in mass production work, build their tools only for a life of five years, during which the tools must pay for themselves. This enables the user to take advantage of the improvements that are so rapidly being made, or to discard the tool without loss.

There is a tendency, also, to purchase tools for mass production where mass production is not required. Buying a tool for mass production where mass production is not needed not only increases the cost of the tool, but in most cases, also, increases the cost of the work performed on account of the time necessary to make the changes in the dies, jigs, holders, etc., that are necessary in mass production. The storekeeper of a railroad, when ordering small quantities of material, often hears the complaint that it costs more to change the machine than to perform the work, and the shops ask for a large order so that the work can be done cheaper. It costs at least 15 per cent of the value a year to carry unused material in stock so that it becomes important, where the mass production is considered, to be sure that mass production is justified.

Must foster competition

Requisitions for tools should give the size, make, design, purpose, material best suited for construction, the estimated cost, the estimated life desired, and the wearing parts that will require replacement. The names of manufacturers of the tool should also be given, but no requisition should insist upon the purchase of one particular make of tool as this prevents competition. The purchasing agent deals with thousands of items and, if he is to protect the railroad, must have the information and be free to deal intelligently with the seller.

The purchasing of tools also requires time. The stockman handling tools in a storehouse probably has several thousand other items of material to look after. He must know the quantity of each of these items on hand, the quantity due, quantity for which he is holding orders from others, and the quantity used during the last ordering period. For each one of these items he must write a requisition and send it to the general storekeeper for checking before it is sent to the purchasing agent. The purchasing agent usually must send out an inquiry with the detailed description of the tool to all the manufacturers or jobbers. The manufacturers and jobbers take several days to prepare their bids, and, after the bids are submitted, representatives make personal calls, explaining their bids in detail. The entire procedure takes time, and the planning of needs by tool users is required to offset it.

Those who order material also should know their purchasing agent and have an occasional visit with him. It is much easier to discuss problems across the table than it is by correspondence, and the user will find that by this acquaintance the purchasing agent is better able to serve the users' interests. A purchasing agent's desire should be to purchase what users want, but he also carries the responsibility of conserving the company's money just as far as possible, still furnishing the article that will do the work required. The purchasing agent must know whether manufacturers are offering a tool made too cheap on the one hand, or too elaborate and high priced on the other, and he needs the co-operation of tool foreman for this purpose.

More facts on tool merits

In too many instances on railroads, operations are based on individual opinions rather than on facts as to their value in dollars and cents to the company. It is essential that users of tools know the cost of their tools, not overlooking the overhead expense, including the cost of the land for the work to be done, cost of the buildings, taxes, insurance, repairs, obsolescence, interest, cost of power to drive, etc. It is important to take into consideration all these factors before tools are purchased. The man equipped with this information is protected from embarrassment to himself and is likely to get what he orders.

I am a firm believer in operating on a dollars and cents basis, rather than in terms of piece output or performance. The thing that counts is the amount of money in the treasury, and we can only keep money in the treasury by spending it where it produces more than is taken out. The dollar sign should be associated with every design and piece of work to be performed. The dollar limitation always forces better tools and cheaper work, as it forces closer supervision.

I am also a firm believer in the budget as a means of controlling the expenditures. If a tool room is given a certain amount of money to spend, the probability is that it will be spent for tools that will give the greatest return to the company, and at the same time, produce the best showing for the individual. A railroad, like an individual, has more requests for expenditures than dollars to spend and must regulate these expenditures to keep within its income.

W. R. Millican (M.-K.-T.)
First vice-president

H. P. Jones
(Oregon Short Line)
Second vice-president

A. A. Ferguson (Mo. Pac.)
Third vice-president

G. G. Macina
Secretary-Treasurer

Consolidate tool orders

Requisitions for tools, replacements and repair parts for tools should also be consolidated as much as possible. It is much easier to get a better price on quantities than on individual items. In addition to that, it is possible to get a better product, as the larger the purchase, the more time is spent in purchasing and the greater is the desire of the manufacturer to furnish the most acceptable product. The American manufacturer relies on mass production for profit. Requisitions for similar material should be sent in from all parts of the railroad at one time—monthly, quarterly, or bi-yearly, as the needs demand—and be submitted by the storekeeper to the purchasing agent in one unit as nearly as possible. This not only enables the purchasing department to benefit by quantity purchases, but makes it worth while for a competent supervisor to go over the order and inspect the tools. It reduces handling and checking in the storehouse and affords an opportunity to substitute

new tools for old ones at the points where they will do the most good, and to forward the old tools to the points where their use is less in demand. By this method, it is possible to spend money for tools most advantageously.

The best tool a railroad has is a competent man. If he can be standardized so that his requisitions and his operations are simple, understandable, workable, coherent, economical and progressive, the work will be well done, the department successful and the stability of the road improved.

Car shop tools

By P. Kass

Superintendent of car department, Chicago, Rock Island & Pacific, Chicago

I am appreciative of the debt that we owe our tool room organizations for their part in the development of machine tool methods which have enabled us to reach the high shop efficiency that we are working to.

Car department tools represent a phase of the railway tool situation that, I believe, is largely overlooked. Going back to the days of wood car construction, the large majority of our men were carpenters, who owned their own tools and looked after their own maintenance and repair. Today, the situation is greatly different. While we still have the carpenters, we also have the steel workers and others who are using company-owned tools, the maintenance and repairs of which are taken care of by the company, which maintenance and repair is a responsibility of the tool room organization.

To enumerate briefly, these tools include wrenches of all kinds, open end, "S," pipe and special types; bars of all kinds, pinch, chisel, dolly, bucking and special types; hand chisels, drifts, hammers, sledges and tools of this nature; jacks of all kinds; pneumatic hammers, rivet cutters and motors; electric drills, welders and motor-driven equipment; drills and reamers; rivet heaters; clamps, special drilling jigs, straightening devices, and other jigs.

The first and most important factor having to do with these tools is the proper instruction for their use, and the proper care on the part of the carmen using them. Every employee should take just as good care of company-owned tools as he would of his own. He should see that they are all gathered up before leaving the plant and not allowed to be scattered around on the ground or on the car, resulting in damage to, and loss of tools. A point should be designated to which all tools should be returned. This permits the tool room force properly to inspect and repair these tools.

The second factor of importance is the maintenance and repair of these tools, which is the direct responsibility of the tool room organization. This includes the inspection of all tools to see that they are in a safe and wearable condition; to see that all pneumatic tools are properly lubricated; to gage all air hammers to see if they are near the condemning limit for repairs; the grinding of all drills and reamers (the workman should never be allowed to grind drills and reamers, although the grinding of chisels and similar tools can be handled by the workmen); the re-dressing of all chisels and other cutting equipment; the re-cupping of rivet sets, and last, but not least, the design and development of special jigs and fixtures for reducing time and increasing efficiency of operations.

The third factor of importance is the tool room equipment needed to handle this maintenance and repair work. This, of course, will be largely influenced by the size of the plant, but, in general, it should include drill and reamer grinding equipment, if the amount of drills and reamers in use are of sufficient number to warrant. If not, then they should be sent in to a central tool room for grinding. If it becomes necessary to send tools to a central tool room for repairs, such central tool room should handle this equipment with dispatch, and the local plant supervisor must equip himself with sufficient tools to carry him through while he has tools tied up for repairs.

The tools used by the car department are not unlike those used in the locomotive department in general. However, the degree of accuracy required in car work is not as great as that required in locomotive work. But in selecting these tools, the conditions surrounding their use should be given careful consideration. For example, the standard length steel drill and reamer are more of a handicap than an advantage in the general run of car work, whereas the short car drill and reamer have been found to afford quite a saving.

Shop jigs and devices

Never before has labor-saving equipment loomed so large as it does today in the mind of the progressive tool foremen. We always keep in mind that we can discharge an inefficient workman; then why can we not discharge some of the inefficient equipment? To sum it up, the user should fill his floor space with the best equipment to be had, then strive legitimately to wear it out, finally sending it to the scrap heap with a clear conscience and replacing it with something even more up to date.

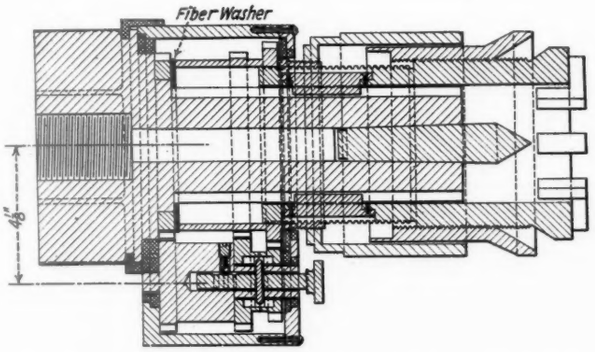
Modern production requirements demand the utmost efficiency of available tool equipment. Changes in design and in production methods necessitate constant improvement of tools and equipment. New problems arise from day to day which tax the ingenuity and ability of the tool designer. The solution of a particularly troublesome problem is occasionally found by the introduction or practical application of an entirely new method. The interchange of knowledge gained by such experience, through the medium of technical magazines, and also at conventions like this of the American Railway Tool Foremen's Association, results in great benefit.

We all know that idle machines are a source of expense and that, if they are not operated at maximum efficiency, the production costs are unnecessarily high. Often the machines do not even pay for the space they occupy. The function of a machine tool is to drive a piece of work past a tool which cuts or forms the work to shape. The cutting tool may be comparatively small in size, but its efficiency is a very large factor in determining the machining cost. Unless the most efficient tool equipment available is employed, a shop must operate at a great disadvantage as compared with one in which the tool equipment is kept up to date.

The importance of giving the tool equipment careful attention is indicated by the saving in production time which results from the installation of improved jigs and shop tools. A device adaptable to the machining of union links, for example, is shown applied to the rotary table of a milling machine, for machining the straight sides and the radius on each end of the union link. A helical milling cutter is used in the vertical head of the machine and allows a straight cut to be taken from the center of the link to the beginning of the radii of the end, the rotary table then being used to machine the radius and finally finish the straight cut on the other

side of the link. The link is then changed end for end and the operation repeated.

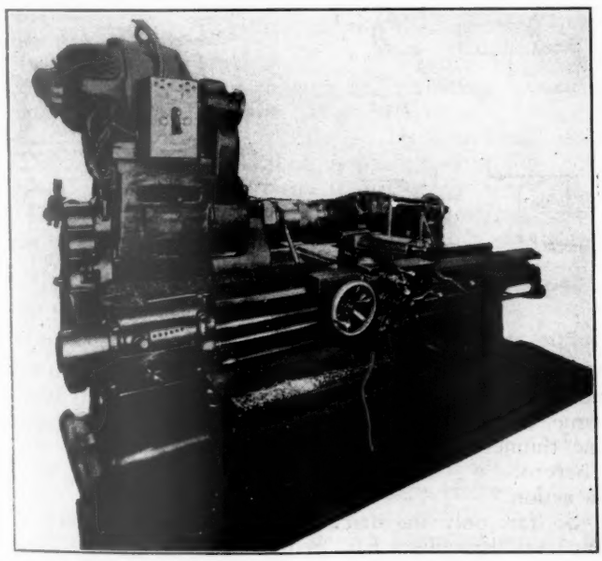
The details and assembly of a device for the machining of the bearings of link cheeks are shown in two of the illustrations. The device is placed on the spindle of a lathe and the assembled link is machined between centers, insuring perfect alinement of both bearings. The device is self-feeding, having two feeds obtained through gearing and a threaded sleeve. The cutter is of the hollow-mill type with six cutters. This turns the diameter to any desired size and also faces the boss on



Details of hollow-mill type cutter used in making link check bearings

the link cheek. After one side has been machined, the link is changed end for end and the other side machined. This assures accurate centering and alinement of the two bearings, not otherwise easy to obtain.

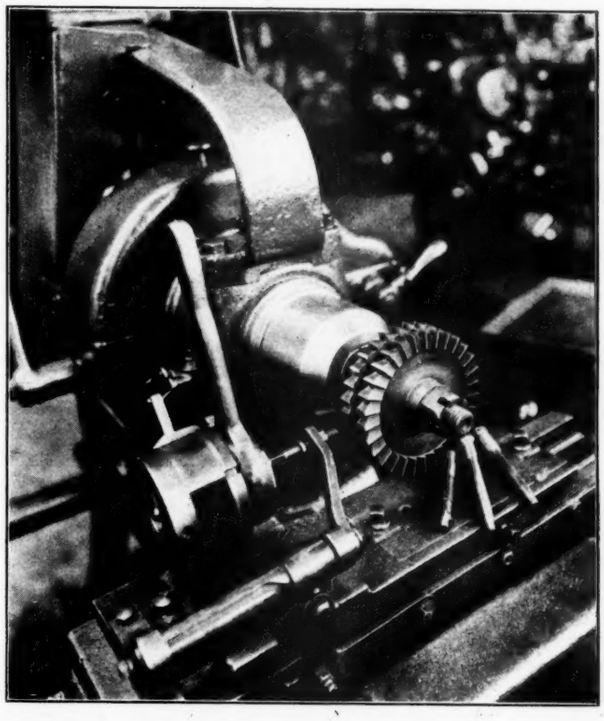
In order to secure a good fit in the crosshead on the taper fit of the piston rod, a machine for lapping the fit was developed and is illustrated. The machine is driven by a pneumatic drill through a chain of gearing arranged to reverse the motion of the work and at the



Arrangement for machining link check bearings in heavy duty engine lathe

same time advance the work further in one direction than the other, which in time makes a complete revolution of the work and a uniform bearing of the lapped surfaces. In addition to this, the machine automatically raises the crosshead from the taper fit, allowing the abrassive to distribute itself over the fit to be lapped and preventing the freezing of the joint.

An attachment for milling the square ends on valve stems is shown, made to slip on the carriage of a brass lathe in place of the tool post. It consists of a T-section of steel with a collet chuck, with a latch to lock it in positions of 90 deg., also different size spring collets for the different sizes of valve stems. The stop for setting the stems so that each will project the same from the collet is arranged with a cam which swings it out of the way of the cutters automatically, and a stop on the cross slide of the lathe makes it so that each valve stem will be milled back the same distance. An arbor is fitted to the lathe spindle to receive two side milling cutters, with a spacer between them to correspond to the size of square required. With this attachment a man can mill three stems per minute.



Brass lathe attachment for milling square ends on valve stems—Roanoke shops of N. & W.

(The report was signed by Chairman W. R. Millican, tool foreman, Missouri-Kansas-Texas, Parsons, Kan.; C. O. Wiggins, tool foreman, Chicago & Eastern Illinois, Danville, Ill.; J. D. Mays, tool foreman, Florida East Coast, St. Augustine, Fla.; R. L. Nutter, tool foreman, Boston & Maine, Lowell, Mass., and H. F. Williams, tool foreman, Santa Fe, Albuquerque, N. M. Other shop devices discussed by the committee will appear in a subsequent issue.—EDITOR.)

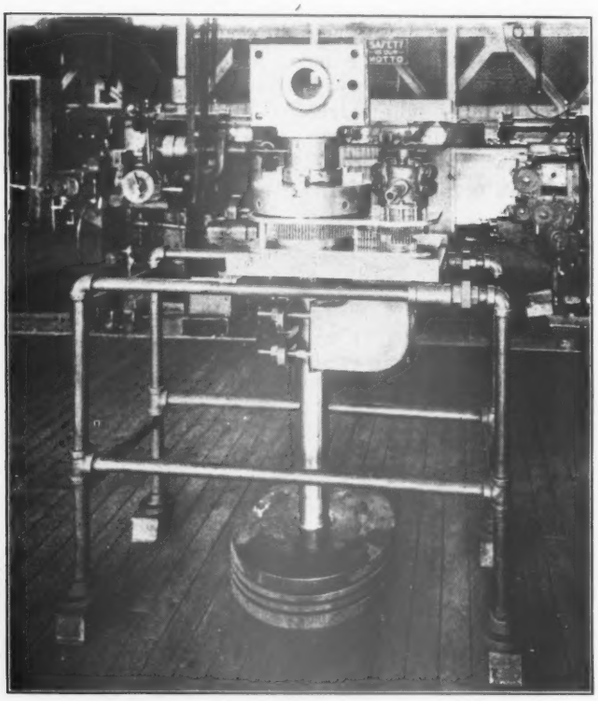
Rake and clearance of machine tools

The factors encountered in designing cutting tools are so many and varied that a clearer idea may be gained by a study of the basic principles involved and outlined herewith.

The object of cutting tools and the aim in all good

tool designing is to remove the surplus metal with the greatest rapidity and least possible amount of power so as to leave the final product in just the size and shape desired.

Theoretically, the least amount of power is consumed if a cutting edge of invisible thickness were passed between the work and chip. One could conceive that if the tool *T* as shown in Fig. 1, was thin enough, the chip



Machine for lapping crosshead taper fits at Parsons shops of M.-K.-T.

C could be removed from the work *W* with practically no use of power or, at least, only enough to separate one layer of iron particles from the other. Actually, in practice no such condition can ever exist. Tools must have an appreciable thickness and, therefore, we are compelled to bend the chip to suit the size of the tool more nearly as shown in Figs. 2 and 3. In view of the foregoing the ideal to strive for is: "Remove the chip with as little distortion as practicable."

Having taken care of the chip, we will next examine the tool. All other things being equal, the best cutting tool is one that has the greatest amount of metal back of the line of cutting force. Fig. 3 shows a tool bit cutting on its end and Fig. 4 shows one cutting on its side. A simple test of this rule can be made by holding your sharpened pencil on its end against a hard object and noting the considerable force necessary to break the brittle pencil point. Now turn the pencil sidewise and note the comparatively slight tap or force necessary to break the point when held in this position. The rule resulting therefrom is simply: "Get as much metal back of the cutting point as possible."

Another problem which is always present in cutting tools is the disposition of the heat generated. The speed at which a tool will cut metal depends solely on the speed with which the generated heat can be carried away. A cutting speed of 1,000 ft. per min. would be possible if the tool could be kept below the temperature that it loses its hardness. Since steel is a better conductor of heat than the surrounding air, tools should have as much material near the cutting edge as is practicable for each job.

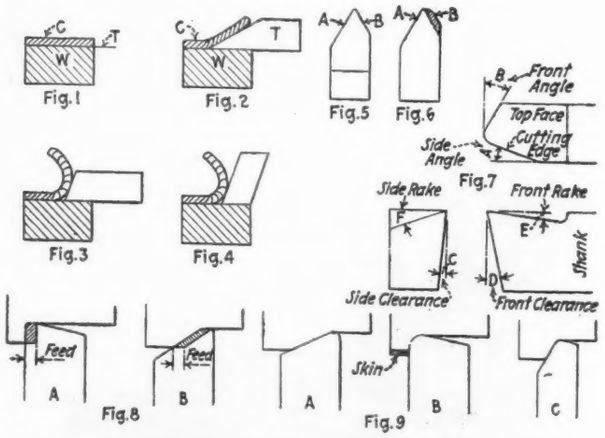
On referring to Figs. 5 and 6, it will be noted that the cutting faces of each tool are identical, but in Fig. 5 the backing *B* has been ground away, a very common practice in many shops, while in Fig. 6 the backing is only removed sufficiently to keep the tool from dragging in the back. Obviously the latter tool will carry away more heat and will therefore stand up longer under similar conditions.

Solid tools

We will next take the tool itself and examine it regarding these thhree points—profile, clearness and rake.

Before proceeding with the study of the cutting tool, it might be well to define the terms used to designate the various parts of it. The side angle is the angle that the tool is presented to the cut at right angles to the center of rotation. The front angle is the amount ground away on the back of the tool to keep it from dragging. Side clearance is the amount that the tool is relieved to keep its side from rubbing on the work. Front clearance is the amount that the tool is relieved to keep its front from rubbing on the work. Rake is the angle at which the top of the tool is presented to the work. It is usually a combination of front and side cutting angle, or it may consist of either separately.

The profile of a tool has a far greater bearing on the efficiency of its cutting, than is usually realized. To illustrate this point, we will take for example the two tools *A* and *B*, as shown in Fig. 8, cutting at the same

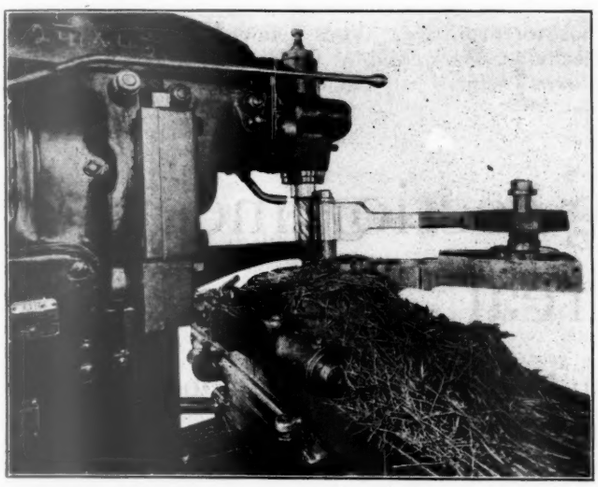


The principles of cutting-tool contours

speed per revolution and the same depth of cut. You will note that since the cross section area of the chip is the same, the tool with the longer cutting surface will have the thinnest chip and naturally have the longest life. Therefore, a good rule is: "Get the longest cutting edge in action."

So far, only the machining of material of uniform hardness throughout has been considered. We all know that the tools in every machine shop show the effect of surface scale and grit on their cutting edge from machining material with a hard surface. When cutting material of this kind, the cutting edge presented to the surface scale should be shorter. The wear on the tool will then be less, so it should be borne in mind to: "Keep the cutting edge that breaks the scale the shortest."

The disposition of the heat generated should next be considered. Clearly, the tool with the most metal near the cutting edge has the greatest chance of preventing the cutting edge from being heated beyond the point where it lowers its temper. This point is illustrated in Figs. 5 and 6, where the tool has the additional shaded portion *B* to aid in carrying away heat. A simple rule



Device for machining union links, developed at Parsons, Kan., shops of M.-K.-T.

for this purpose is: "Have as much metal near the cutting edge as possible."

The application of the three laws of profile must necessarily depend on local condition of the specific case in question. Hardness of the work affects the profit as well as the rake of a tool and should be taken into consideration in determining the feeds possible to adopt. The surface scale also has a decided effect on the shape of the tool to be used.

Rigidity of work

Consideration should be given to the strength, power and rigidity of the machine to be used, especially the rigidity of the tool support. Work that is liable to spring should be machined with different feeds and cuts than heavy rigid work. The tool, as illustrated in Fig. 9-*A*, would be ideal on a soft steel forging where the surface is clean and free from grit or on a heavy machine with plenty of power where the forging is heavy enough to not spring away from the work.

If the forging should have a tough scale on the surface which is destructive to the cutting of a tool, Fig. 9-*B* shows change in the tool necessary to get a short cutting edge to cut the hard surface scale and yet have length of cut by the use of large radius.

To further illustrate this problem, suppose that the machine available is limited in power and the work is liable to spring. This will require a tool as illustrated in Fig. 9-*C*, that will have a sharper angle if the depth of the cut is to be maintained.

Thus, examples with different variables could be worked out, but these will suffice to show the importance of profile on tool design and it should be borne in mind that the right tool will cut at the highest speed, last longer per grind, increase production and use the least power.

Clearances.—Those who have studied the matter of clearances realize that in the ordinary shop it has received little or no attention. A casual inspection of the lathe tools in the average shop reveals the fact that clearances from 2 to 4 in., or as much as is necessary, are used. If we consider that only just enough clearance to keep the tool from rubbing on the work is necessary and that "A miss is as good as a mile," better cutting tools will result. It is well to consider some of the factors regulating the amount of clearance necessary.

On flat surface work, such as planer and shaper work, the side and front clearances are very nearly identical. But on the lathes, front clearance is aided by the round work receding from the tool which gives a chance for smaller front clearances. While the side clearance has to be sufficient to take care of spring in the work plus the angle caused by the rate of feed along the work, the rate of feed affects the amount of clearance needed. Obviously, for practical purposes it would be desirable to limit the different side clearances used to as few as possible. It has been found that a side clearance of 6 deg. on turning a 3-in. shaft is ample to clear a feed of .500-in. which is never obtained and yet does not seem to weaken the tool greatly on feeds that are obtained. A good way is to rough grind the tool to 6 deg. side clearance and then only touch up the cutting edge after hardening. There are many cases, such as parting tools, where much less clearance is desirable.

Rake.—There are a great many different ideas on the amount of rake that a tool should have. So many in fact that we should go back to the fundamental conception that the chip should be removed with as little distortion as possible. The limiting factor as to the maximum rake is solely a matter of strength of the tool. The thinner the cutting tool, the less the chip is distorted, the less power used, and the less heat generated. Practically, however, the amount of rake to use becomes a series of compromises from the above ideal. Rake must be closely connected with the kind of metal to be cut. We require a different rake for steel, cast iron, brass and copper, etc. The subject of rake is so broad that only a short summary of the classes of material to be worked can be given here.

The resistance of metals to cutting action divides them naturally into a number of groups, as follows.—

1 Soft and tenacious—including very soft steels and copper.
2 Tough, but fairly easy to cut—including the majority of low carbon steels and certain kinds of bronze.
3 Very tough and difficult to cut—including carbon steels, tool steel and most alloy steels.
4 Brittle—including ordinary unchilled cast iron and some grades of bronze.
5 Very brittle—including most brasses and chilled cast iron.

Each of these groups requires a different rake. The metals in Group 1 demand keen-edged tools, while the brittle ones in Group 5 require little or no rake and with some materials, such as stelite, even a negative rake.

The majority of work falls in Groups 2 and 4. For practical purposes, if a good supply of tools is carried for these groups, changes for odd jobs on Groups 1 and 5 are easily made.

Tool Face.—One of the most neglected phases of cutting tools is the tool face. Everyone who has operated a lathe has noticed that tools which have been running some time and are still cutting well will build up on the cutting edge by fusing on a portion of the metal cut, and that a curved pit has been carved out just back of the cutting edge by the metal being cut. Any good operator knows that a tool cuts better in that condition.

This condition brings up the question of originally grinding the tool to the shape that it naturally takes after a little use. Considerable work has been done in Europe along this line. The Klop stock patterns in Germany and the curved tool face of Alfred Herbert Company in England are worthy of careful study.

Practically every book on machine shop practice gives

us data as to the proper rake and clearance to use. A little study in one's own shop will generally reveal the fact that figures given on rake tend to the minimum and with a little care on the part of the operator rakes much higher than those given can be used to good advantage.

Blue Chips.—The old rule of "Drive the tool until the chips are blue" should be discarded. The only thing that a high-colored chip tells is that the tool will not stand much more in its present shape. There are many cases on record where a tool which was producing beautiful blue chips was replaced by a proper-shaped tool driven at high speeds and greater feed without even discoloring the chips. A blue chip can, and often does mean wasted power instead of maximum production from the machine tool.

(The report was signed by J. E. Carroll, chairman, supervisor of tools, Chesapeake & Ohio, Huntington, W. Va.; J. C. Howard, tool foreman, Fort Worth & Denver City, Childress, Tex.; N. W. Johnson, tool foreman, Illinois Central, Waterloo, Iowa; G. F. Harney, tool foreman, New York, New Haven & Hartford, Readville, Mass., and A. C. Roepke, machine foreman, Union Pacific, Los Angeles, Cal.)

Equipment painting section meets at Montreal

Spirit of meeting shows that aversion to lacquer is rapidly disappearing—Fire hazards and effects on health discussed

THE three-day session of the Equipment Painting Section, Mechanical Division, American Railway Association, was held at the Windsor Hotel, Montreal, Que., September 11, 12 and 13, 1928. This meeting, which was the seventh annual meeting of the Section, was also the fifth-eighth anniversary of the organization of the former Master Car and Locomotive Painters' Association. The attendance, numbering approximately 350, was slightly greater than the attendance of members of the section at last year's meeting.

On the opening day of the convention, an address was made by G. E. Smart, chief of car equipment, Canadian National, and an individual paper on the subject of "Finishes" was presented by Dr. Paul S. Kennedy of the Murphy Varnish Company, Newark, N. J. At this and at later sessions, the following committee reports were presented and discussed: Shop construction and equipment; maintenance and care of paint and varnish at terminals; ornamentation of cars and locomotives; equipment painting practices, and new developments in equipment painting with economies involved. Abstracts of some of the papers and reports appear in this issue.

Much of the discussion during the three-day session centered around the fire hazards and the dangers to the health of workmen connected with the use of lacquer finishes. One of the committee reports was criticized because of the fact that no definite recommendation was included for the elimination of fire hazards. One of the members made the statement that many fire hazards are not due to painting practices at all and can not, therefore, properly be included in a report to the Equipment Painting Section; that many of the so-called fire hazards are due to the operations of welders and electricians and that the officers of the railroads must recognize this fact and eliminate the dangers by placing proper restrictions on the activities of these workmen. It was pointed out by experts during the meeting that, as far as fire is concerned, lacquer is practically as safe as varnish and is safer than varnish remover, and that it has a higher flash point than either. It does however require an actual fire point to cause

L. B. Jensen (C. M. St. P. & P.)
Chairman

D. C. Sherwood (N. Y. C.)
First vice-chairman

Marceau Thierry (N. & W.)
Second vice-chairman

danger. The hazards may be removed by eliminating the source of actual fire, sparks, etc.

As to the danger to the health of workmen, it has been shown that where lacquers do not contain benzol there are not only no detrimental effects, but that in some cases workmen using modern lacquers show an improvement in health. It seems that the aversion to lacquer has been due to the inclusion of benzol in the early lacquers and that the better grades of lacquers made by reputable manufacturers do not now contain this injurious chemical. The spirit of the convention indicated a disappearance of the objections of these new finishes due, in part, to an improvement in the quality of the product.

Opening addresses

Chairman L. B. Jensen, in his opening address, dwelt on the importance of the annual meeting of the section. He said the members are united in research for the promotion of all the things that result in greater efficiency and also the necessary study of new developments to meet the ever-arising problems in equipment painting. He pointed out that many painting tests and studies have been made recently.

Mr. Smart, in his address, paid tribute to the work of the Equipment Painting Section, mentioning particularly the care that has been taken in preparing specifications for the painting of new equipment in order properly to protect those parts of the cars which are concealed and are difficult of access. Continuing his remarks, he said that the railways have made great progress in the construction and maintenance of equipment and every consideration is given to the provision for maximum strength and safety. Everything practicable has been done to provide additional comforts so that railroad travel may be made as pleasant as possible, while at the same time the proper consideration has been given to the question of cost. At the present time the factor of interior decoration is being accorded the consideration that its importance warrants. He said that he did not believe anyone would care to witness the return of the old-fashioned gaudy decorations of past years, but that we have gone to the other extreme in being too plain in the interior painting of passenger cars. Mr. Smart mentioned that the lacquer method of finishing is being tried out on Canadian roads; that so far the results have been satisfactory, and while there may be great possibilities under certain conditions and services, he was of the opinion that the railroads will not wholly adopt this system until they have assured themselves that it will give as good, or better service under all conditions as the varnish finish in use up to the present time.

Election of officers

The following officers were elected to serve for the year ending September, 1929: Chairman, D. C. Sherwood, foreman painter, New York Central, West Albany, N. Y.; first vice-chairman, Marceau Thierry, foreman painter, Norfolk & Western, Roanoke, Va.; second vice-chairman, Frank B. Davenport, foreman painter, Pennsylvania, Columbus, Ohio.

The following members were elected to serve on the Committee of Direction for a like period: J. W. Gibbons, general foreman, passenger car department, Atchison, Topeka & Santa Fe, Topeka, Kan.; H. Hengeveld, master painter, Atlantic Coast Line, Waycross, Ga.; K. J. Johnson, foreman painter, Nashville, Chattanooga & St. Louis, Nashville, Tenn.; B. E. Miller, master painter, Delaware, Lackawanna & Western, Kingsland, N. J. A. E. Green, foreman painter, Chicago & North Western, Chicago, and E. M. O'Brien, foreman painter, Illinois Central, Chicago. J. W. Gratton (B. R. & P.) a past chairman, will also serve the committee and L. B. Jensen, the retiring section chairman, will act as chairman of the committee. The association voted to hold next year's convention at Kansas City.

Finishes

By Dr. Paul S. Kennedy
Murphy Varnish Company, Newark, N. J.

Never before in the history of the finishing industry—with both supplier and user—has there been such confusion; such wide differences of opinion, and such strong and radical prejudices. This condition, while disturbing, is fundamentally healthy. In brief, an army of research chemists have suddenly invaded uncultivated ground of great promise and are unearthing developments faster than we can absorb them.

Both the manufacturer and the user have, through many years, acquired habits of conservatism which have been rudely upset by the swamping of the market with new types of materials, for some of which, unfortunately, extravagant and exaggerated claims have been made. It is little wonder that we should have reversals of opinion and that some of us should become extremely skeptical. But out of all this chaos, there is one overshadowing fact and that is a determined and conscientious effort to accomplish a radical advancement and improvement in finishing methods. And what is more, it is positively certain of accomplishment.

We must work together to accomplish it, and the first move is the manufacturer's. He must educate his salesmen—our mouthpieces—so that the information given to one is accurate and not imaginative. That specialized education is vital in restoring order from the confusion. The next step is up to both of us.

Let us adhere strictly to the term "finish" and eliminate odious comparisons between varnish and lacquer, for example. When all is said and done both are "Finishes"; both have their place, and neither should suffer by criticism of the other. The end we are all striving for is a better finish. The means to the end are incidental. We want a better finish regardless of what it is made.

"Finish" was first heard of in China in 560 B. C., when lacquered articles began to make their appearance. In 392 B. C., it was officially recognized by appointment of the Emperor of China of a Chief of the Imperial Lacquer Department, and much of the Royal Plumage, such as head dress, etc., was lacquered.

In 243 B. C., Queen Berenice of Egypt dedicated a lock of her famous amber-colored hair to one of the temples. It disappeared, and it was announced by official canon that it had been taken into the heavens as a constellation which was known as "Como Berenice" and perpetuated in the words "vernice," "vernis" and "varnish." Where could there be a finer example of the old adage that "History repeats itself?" Well over 2,000 years ago, we had the Chinaman talking about "lacquer," and the Egyptian talking about "varnish." Today we have exactly the same situation. Certainly there was no nitrocellulose 2,500 years ago when the word "lacquer" was created. The Chinaman called it "lacquer," and the Egyptian called it "varnish," but they both meant finish.

The first varnish approximating the present day composition was made by the French in the seventeenth

century. The first record of carriage varnishes being made in London was in 1776, and the maker was an escaped French refugee.

Varnish was first made in this country in 1807 by a German hired by William Tilden, and the first varnish factory in this country was the firm of William Tilden and Nephew, located at 115 Norfolk Street, New York.

Nitrocellulose lacquers

Nitrocellulose, or nitrated cotton, was first discovered in Austria about 1860, but it was not adapted for use in solution until 1888, when the development of amyl acetate provided a suitable solvent.

Nitrocellulose base lacquers had been used in the arts, mainly on metal, from that time until the development of low viscosity nitrated cotton, just after the war.

This treatment of cotton has made possible the present day lacquers, as a solution of working body can be made of desirable film thickness. Formerly, only a few ounces of cotton could be dissolved in a gallon of solvent, and have the material workable.

Following the actual advent of varnish itself in this country, the first outstanding advance in present day finishes of particular interest to the railroad man occurred fifty years ago when surfacer was first developed in its present-day form for the filling of wood and metal surfaces. Our next milestone is about 1900, when china wood oil was first brought to this country in quantity. Up until then, linseed oil had been exclusively employed in varnishes, and in the early days, china wood oil was generally regarded as an adulterant. As a matter of fact, china wood oil made possible the first fast-drying waterproof varnishes, and combination varnishes made of both china wood oil and linseed oil. These two oils are more or less inter-dependent, for the weakest points in one are the strongest in the other. Properly combined, they compensate so that a varnish made from both is generally superior to one made solely from either.

Except for the gradual refinements developed with the treatment of china wood oil, the advance in finishing was very limited until about five years ago, when pigmented nitrocellulose base lacquers first made their appearance on production automobiles. This product upset the old theory that "nothing which dried fast could be durable" and paved the way for the period of abnormal development through which we are now passing. "Speed" became the dominating cry and demand of the average consumer.

The finish manufacturer was aroused from his complacency. He realized the need of extensive research laboratories and that the control of manufacture and development must pass from the "cut and dry" hands of the practical man to the trained technical man. Scientific research was no longer an incidental part of finish manufacture, but a vital necessity.

The smart manufacturer recognized in nitrocellulose base lacquer just another promising finishing material, and not a cure-all. So he divided his now-enlarged laboratory force, delegating one group to the development of this new type of finish, and a second group to a real investigation of the possibilities of the varnish raw materials which he had been using so casually all these years.

The surface has only been scratched as yet, but there has been uncovered a mine of hidden treasures.

The constituents are changing constantly

Pigments which were popular yesterday are passe today. We have whites which cover beyond the imagination of the last generation. Colors which were noticeably fugitive are now fast to light, and pigments regarded as hard settlers, or extremely difficult to grind now hold up in suspension, or go through the mill smoothly.

Metallic pigments, such as zinc and aluminum, in balanced combination with the proper type of vehicle, indicate priming properties of invaluable merit; and aluminum, in particular, is finding great favor as an exterior and interior coating, especially in buildings like railroad enginehouses, because it combats discoloration with sulphur fumes and resists rough cleaning methods.

Varnish gums, or resins, have provided an even more fruitful field. Gums which were formerly regarded as soft and sticky and not durable—even the despised rosin—can now be converted by synthetic combinations into harder and more serviceable products. Synthetic chemical resins can now be produced which are not only hard and good builders, but which actually exercise a decided drying effect on the finish and add immensely to durability. These chemical synthetic resins form the base of the so-called four-hour type of varnishes of which you now hear.

But it is with the oils—notably china wood oil and linseed oil—that the greatest possibilities exist because there are untold opportunities awaiting for the development of fast-drying materials, without sacrificing durability, through scientific treatments.

It is possible with linseed oil, for example, to produce with special light treatments bleached oil of extremely pale color, and yet of such heavy body that it will take a bubble of it over forty minutes to travel a given distance in a measuring tube. These treated linseed oils possess not only drying advantages, but also give increased durability, fullness and lustre to the finished product.

Constituents of china wood oil have been precipitated, by the action of light, which go into solution to produce a lacquer-like product which will dry in a few minutes.

While some of these discoveries are as yet in the laboratories of the finishing manufacturer, they must indicate to you that the day of quick drying and durable varnish type coatings is close at hand.

Turning to the lacquer type of finish, we find other results of research.

Synthetic materials make modern lacquers possible

Amyl acetate used to be regarded as indispensable in lacquer making. It was made from fusel oil, which in turn came from whiskey. This source of supply diminished with prohibition, but the chemist got busy and made a synthetic butyl acetate from corn, which has become a universal and satisfactory substitute. Just recently, a synthetic amyl acetate has been made and is now being used commercially.

Research has also produced a synthetic product which might be regarded as a substitute for nitrocellulose itself.

Clear lacquer made from nitrocellulose base will not wear out-of-doors and neither clear nor pigmented nitrocellulose lacquers give a satisfactory performance on wood surfaces, particularly outside. It is possible with this synthetic development to make a fast-drying lacquer in the clear and pigmented form which will meet all of these conditions. From these facts, we must conclude that we are en route to new and improved finishes.

We all know that varnish has its drawbacks and that nitrocellulose lacquer has its deficiencies. On the other hand, we must admit that both have good points as well.

It is to our future interest to cash in on these good points; to refrain from decrying the weak point, and to unite our efforts to produce a better finish, regardless of what it is made of.

The ideal finish

The ideal finish of the future can be simply described to meet three specifications:

First—It must combat the ultra-violet rays of sunlight. These rays are our common enemy. It is these rays which ruin colors of the ultramarine blue and maroon type in particular, and penetrate other pigments to a greater or lesser degree, setting up destructive chemical actions with the vehicles.

When these rays impinge a coat of clear nitrocellulose lacquer, they produce a chemical reaction which results in the formation of oxides of nitrogen, which, on combining with moisture, form nitric acid which destroys the film. When these rays enter a clear varnish film, they stimulate the oxidation of the varnish, producing a state of combustion which hastens the death of the varnish film in direct proportion to sun exposure. Another glaring example is the effect of these rays on vehicles mixed with, or applied over, gold bronze.

The ideal finish must produce a film to stop these rays—or if it does not stop them, a film in which these rays will dissipate with no chemical reaction of destruction. This is the ultimate objective of every manufacturer of fine finishing materials, and its accomplishment will automatically produce highly desirable durability.

Second—It must be fast in its performance. Maximum speed—without sacrifice of durability—is obviously to be desired.

Third—It must be reasonably safe. It should contain no ingredients dangerous to the health of workmen, nor nothing hazardous under normal working conditions.

The finish of the future

There is the formula—the goal for which progressive finish manufacturers are striving. The advance will be by steps, rather than jumps, but it is a sure bet that the goal will be attained. Of what, and how, this finish will be secured is anybody's guess.

It may have nitrocellulose in it. It may be the result of synthetic developments with some or all the materials we now commonly employ in varnish. It may be a combination of nitrocellulose and varnish ingredients. It may be composed entirely of some new synthetic material yet to be brought forward. It may be a coating produced by a chemical reaction which will occur during evaporation and cause two or more ingredients, which remain inactive while in solution, to combine chemically, and harden to an entirely different product on exposure to the air. It may be two liquids which will be applied one after the other, to effect a combination. Or it may be a liquid which will contain no thinner, but after being applied will require exposure to some gas or vapor to harden it properly.

None of these suppositions are beyond the reasonable conception of our imagination and we are surely going to have something of the nature I have mentioned some time in the future.

In order to accomplish suitable advancement, the finish manufacturers have a right to expect the co-operation of such an influential organization as yours, which can render invaluable assistance in a practical way.

Speaking on behalf of our manufacturing industry, may I leave just one thought with you. Keep an open mind for the development of the finish of the future; help and co-operate in the various and necessary steps to its accomplishment, and remember that our objective is not for a varnish; not for a lacquer, but for the best finish possible.

We are in business to sell a finish; and you, to use it. We are not interested in what it is made of if it can be produced at a profit by us and used with profit by you.

Report on shop construction and equipment

(Before preparing this year's report on shop construction and equipment, the committee made several inspection trips to modern paint shops in order that its recommendations would embody the latest developments. Among the plants visited were the shops of the Reading at Reading, Pa., the Pullman Car & Manufacturing Company's plants at Pullman, Ill., and Calumet, Ill., and the Standard Steel Car Company's plant at Hammond, Ind. An abstract of the report follows.—EDITOR.)

A floor plan of buildings to be built of structural steel, using either brick or reinforced concrete, is shown. We would recommend, however, that the wall which separates the varnish room from the lacquer or spray room be a 12-in. reinforced concrete fire wall, thereby giving almost positive assurance against any serious mishap to the adjacent buildings either by fire or explosion, which might occur from the use of any inflammable or explosive materials.

The main paint shop is 312 ft. long by 218 ft. wide, which gives ample space for 17 tracks, each track to accommodate two cars, one car on either side of a 22-ft. bay, which extends through the center of the shop from one end to the other, this bay to be used for traffic and for the handling of materials and equipment too, and from the different departments for placement in cars while in the paint shop. The space between tracks is 18 ft., or 8 ft. in the clear after cars are placed which will give ample room between cars, for all purposes. Next to the car paint department, we have the varnish room, and the rubbing room combined. The size of this room is 218 ft. by 88 ft. The following equipment is suggested for the handling of sash doors, etc.: A door rack, such as is now being used by the Nashville, Chattanooga & St. Louis, and the Standard Steel Car Company. For the balance of the varnish room equipment, we still feel that the equipment as offered, and approved by this body at our last meeting, held in Louisville, Ky., and now being used by the American Car & Foundry Company, at Wilmington, Del., be continued, until such time as this body finds something more suitable to their needs.

Next in line and adjacent to the varnish room, we suggest building a lacquer or spray room. While some of us may be divided in our opinion as to whether or not there is any real cause to be alarmed about the hazards attached to the use of certain materials, we must agree at the same time, it is no crime against the other fellow who cries out safety first. Let us, therefore, present to you, what we found to be the best-equipped and up-to-date department, wherein passenger cars are painted by the use of a spray gun. It was while visiting the Standard Steel Car Company's plant that we were privileged to see and inspect this up-to-date equipment.

You will observe in the illustration the large blower

pipe fastened up in the center of the ceiling. At each end of this pipe you will note that it branches out into two separate leads. Attached to these leads there is a canvas pipe which extends down and into the car, and while the car is being sprayed on the inside, the operator keeps moving the blower pipe ahead, as he sprays, thus protecting himself from the vapors or fumes, which are blown out of the car into the open shop, then carried away through the roof by the exhaust ventilators which are plainly visible in the photograph.

Fire protection for spraying operations

When spraying the outside of the cars, the blowers are not used, the exhaust pipes being sufficient to carry off all the vapors and fumes made during this operation.

Each blower and exhaust is operated by a separate motor. The controls for starting these motors and the electric lighting are all located on the outside of this building as a protection against a possible fire or explosion.

The ceiling or roof of this building is of a fireproof material, one side and both ends are of brick construction, the remaining side which separates the spray room from the main paint shop is built up of corrugated iron. The floor is of concrete.

As an improvement to the present flooring, we suggest that the tracks be placed level with the concrete, that between the tracks the floor slope to the center with large drain outlets emptying into a sewer, these drains to be placed at a reasonable distance apart. The floor space between one track and the other to be crowned so that when flushed out, all surplus water will flow down quickly between the tracks and finally out through the drains into the sewer. With this arrangement the entire floor could be flushed out and drained in a comparatively short time.

At one end of this lacquer or spray room can be seen a large booth, which is used for the spraying of sash, doors, strips, etc.

Housekeeping

The necessity for good housekeeping cannot be over emphasized. To this end spray booths, spray rooms, ducts and stacks should be kept as free from deposits as practical.

Cleaning operations in themselves introduce hazards and should be conducted as follows:

Scraping of residues should only be done with non-sparking scrapers, spuds or similar implements, as steel implements may cause sparks. All equipment, including booths, ducts, etc., should be thoroughly cleaned before mechanics are permitted to make alterations or repairs.

Where materials producing dust residues are sprayed, the entire spraying departments, including floors, walls, ceilings, exterior of equipment, etc., should receive periodical cleanings, paying particular attention to heat pipes, lighting and power fixtures, drying ovens, etc.

For paint, varnish, enamel and similar materials, producing sticky, gummy residues that cannot be removed with water, spraying the interior of booths with heavy lubricating oil or coating with cup grease covered with a single layer of manila paper will facilitate cleaning operations.

Safeguarding electrical equipment in the paint department

Working conditions demand the best possible illumination obtainable, and when installed, care should be taken that none but an expert electrician be chosen to have charge of its installation, as well as any other wiring where electrical current is used.

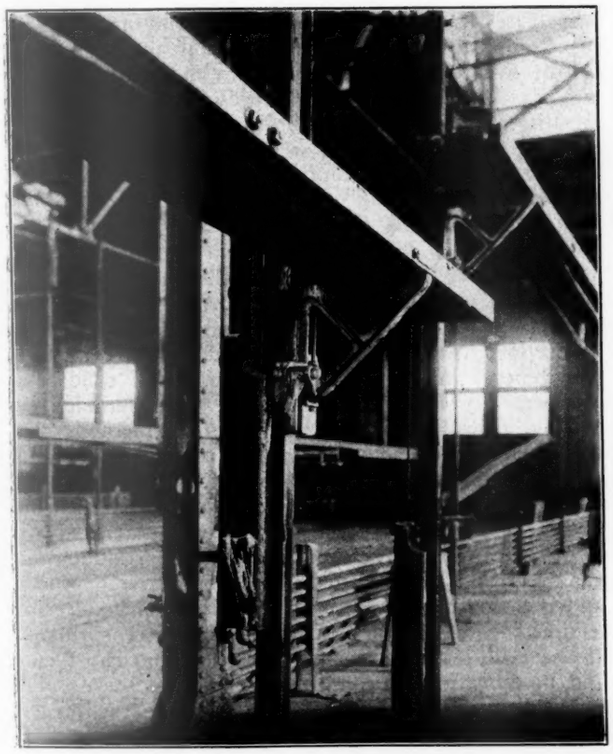
With spraying becoming more essential to efficient

operation, motors are being employed, all of which are being operated by an electric current which presents a new problem. The wiring and necessary appliances must be installed with the utmost care in order to eliminate fire, explosions, etc.

Electrical equipment

Contacts should be carefully guarded. No loose or make-and-break contacts should be in a room where the spraying of any other inflammable materials are used.

Switchboards, panel boards, junction boxes, and portable connections should be made with as much insulation as possible. Lamps should be guarded by vapor-proof fittings and all possible chance for grounding eliminated. For instance, the lamp guard should be insulated, so that a grounded socket will not ground the guard, which would not only shock the workman, but might come in contact with another ground, and thus cause a spark, from which there could be an explosion, should it occur where inflammable materials are used.



A detailed view of the adjustable scaffolding showing counterweight and locking device

Where motors are used, they should have no movable contacts, such as commutators or collector rings with brushes. This would apply to exhaust fans and air compressors that are located in or near the room where spraying is done.

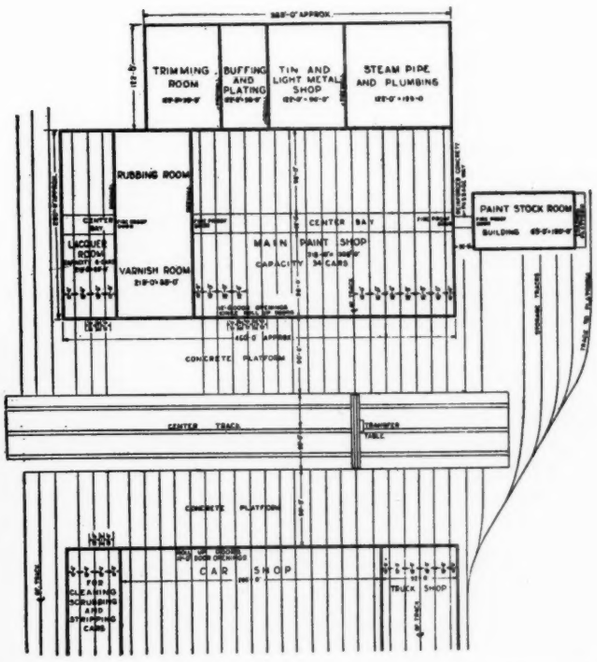
Control devices, lamp sockets and wiring should be enclosed and made vapor-proof, and kept clear of varnish and paint at all times. The wire should be of sufficient size to make it impossible for the intended load to heat it. Care should be exercised with portable cluster attachments not to overload any circuit, and if it does get overloaded, reduce the load, and do not fuse too heavy.

Let us remember that at all times, repairs, inspection, and adjustments should be made by an experienced electrician and should not be tampered with by any one else.

Scrubbing, cleaning and stripping department

As shown in the floor plans, we have provided for a separate shop in which to do the scrubbing, cleaning, and stripping, thus eliminating from the main paint shop, the slop and dirt, which generally follows these operations.

We suggest that this building be in size the same as the lacquer or spray room, having three tracks, two



Recommended layout of paint shop facilities for most efficient handling of car painting

cars on a track, concrete floor, constructed and drained in like manner as the lacquer room floor, thereby making it possible to maintain good housekeeping in this department at all times.

Next to the cleaning, scrubbing and the stripping room is the car shop. Adjacent to the car shop is the truck shop.

With the present layout of these shops, as shown in the drawing, we particularly recommend that a transfer table is very essential in the handling of passenger cars from one shop to another, or when taken from the paint shop to the shipping track.

On either side of this transfer table we show a concrete platform, which extends the entire length of the buildings. These platforms are 90 ft. wide, the shop tracks extending out and across these platforms. This space is intended to be used to spray underneath cars, trucks, etc., before taking them into the shop and can be used for many other purposes to very good advantage.

Scaffolds

We have, after investigation, found in use, several very good scaffolds and we are pleased to be able to recommend the adoption of either one of them with

preference to the one now being used by the Central Vermont. It is a lever hoist scaffold which can be raised or lowered without much trouble. We refer you to the accompanying photograph, which will give those who have never seen it, a clearer conception of how this scaffold is really constructed.

Skylights and ventilation

We recommend that the skylights for these buildings be what is commonly known as the saw-tooth type, these to run parallel with the tracks to insure a better light; these skylights to be built of metal frames, having ¼-in. thick wire glass, bedded in with a good putty; the ventilation for these buildings to be through the skylights, constructed in such a manner as to permit certain sections to open and to be operated by a chain extending down within easy reaching distance.

Doors

We recommend that all track doors for all buildings be of metal and be a roll type of door, which can be hoisted with a chain. This type of door is not only fireproof, but requires less space, and less for repairs than most any other type of door we know of; all door openings leading from one department to another to be protected by a standard fire door of approved automatic or self-closing type, suitable for opening in fire walls.

Sand blasting

In drawing the plans submitted with this report, we have purposely omitted giving any details or location for taking care of sand blasting, preferring that this be taken care of by local conditions, or until the time when the practice of sand blasting becomes more general. It may not be amiss, however, to mention that in looking around during the past year we learned that this work was in most cases done very satisfactorily out in the open, rather than in a building especially adapted for the purpose. At one of the plants which we visited, a car was being sand blasted inside of a building set aside for this purpose. The ventilation and working conditions were very poor and while standing at one end of this building, it was almost impossible for us to see the end of the car nearest to us on account of the dust. We understand, however, that there are buildings wherein sand blasting is done, which are more modern and better equipped, thus eliminating the dust to a minimum. We are still of the opinion, however, that this matter should be handled to meet local requirements, and if found necessary, your committee, one year hence, can make a more thorough report on this particular subject.

The paint stock room, as shown in the drawing, is to be built of structural steel, filled in with either brick or reinforced concrete.

The location of this building should be at the end of the main paint shop with a space of at least 25 ft. between the two buildings, and a concrete runway to extend from the paint shop to the stock room—this runway to be used by the workmen to carry paint materials to and from their work. All door openings in this building are to be protected by a standard fire door of approved automatic- or self-closing type, suitable for openings in fire walls. All shelving, serving counters, racks, cupboards, etc., should be of metal. The floors are to be of concrete and arranged to drain to a safe location. Wire glass is to be used in all skylights and side windows.

Automatic sprinklers should be installed, also a sufficient number of fire extinguishers and sand buckets to be located in convenient places. Ventilation should be provided through the roof, using any of the approved ventilating methods.

The wiring and lighting of this building should be followed out in like manner as was recommended for the lacquer room.

A concrete platform, as shown at the back end of this building, is to be used for the unloading of all paint materials to be used in the entire plant.

The report was signed by F. Clement, master painter, American Car & Foundry Co.; J. T. MacLean, foreman painter, B. & M.; O. S. Minnick, master painter, W. M.; C. E. Ream, foreman painter, P. R. R.; W. F. James, foreman painter, A. C. L.; D. G Richmond, foreman painter, Pullman Co.; W. M. Joyce, foreman painter, Baldwin Locomotive Works, and S. H. Rauenzahn, foreman painter, Reading.

Supplementary report of special committee on fire hazards

(A special committee was appointed by the Railway Fire Protection Association to co-operate with the Committee on Shop Construction and Equipment on the fire hazards connected with the use of lacquer finishes. This committee was present at the Montreal meeting and presented the following comment on the above question as well as a special report on the fire hazards of equipment painting, which is to be presented at the annual meeting of the R. F. P. A. to be held in Cincinnati, Ohio, October 9, 1928.—EDITOR.)

"The railroad problem as we see it is to find practical methods for carrying into effect the rules and standards developed by the complete investigations of the National Fire Protection Association and Railway Fire Protection Association. These standards are more or less general in their adaption to railroad conditions, are perfectly feasible, but involve considerable expense. There is no doubt but that the methods used in the automotive industry are entirely practicable for railroad use. It is only a matter of providing the necessary funds. The automotive industry has learned by practical experience that the only way that pyroxylin lacquers can be safely sprayed and the residues and vapors properly exhausted is to confine this process under a booth, and to provide deluge sprinkler protection for the booth proper with ordinary sprinklers at the ceiling of the room. There are no short cuts, and modification or compromise will not serve. The railroads have been quite fortunate up to the present time in not having had extensive fires resulting from their experiments, but they will surely have them if the work is extended and continues without proper safeguards.

"The rules and standards of the Railway Fire Protection Association and National Protection Association thoroughly cover the whole subject, but they are somewhat general and in all cases the presumption is that the building in which spraying is done is equipped with sprinklers; that is one of the fundamentals upon which the rules are based. Few railroad coach shops have this protection to start with. The work can never be done safely without this protection, unless, of course, they provide a safely detached cheap building to house perhaps one car.

"The most important problem with the railroads in this matter is to get the managements to see that there is a real hazard connected with the application of

pyroxylin finishes by the spray process, and that the cost of taking the necessary safeguards should be balanced against the increased economy which the process brings about. Railroads must recognize that to secure this increased economy without jeopardizing the safety of the property, some change in their old methods of shop operation oftentimes will be necessary."

(The above report and the special report on Equipment Painting which follows were presented by W. F. Steffens, F. T. Edwards, W. F. Hickey and de Witt Rapalje, composing a special committee representing the Railway Fire Protection Association—EDITOR.)

Equipment painting

During 1925 a committee report to the Association outlined some of the hazards connected with the spraying of pyroxylin lacquers and finishes, and some of the steps necessary in order safely to handle this modern process. Since that time sufficient interest has been created in the application of this material to railroad equipment to warrant further discussion as to the practical steps necessary to adapt railroad shops to its use. In the automobile industry the application of pyroxylin finishes by spraying has reached an advanced state, but not without passing through sufficient adverse experiences to warrant all of the precautionary steps now taken by this industry. Briefly summarized, the fires or explosions that have occurred have been due to disregard of the principles covering prompt removal of vapors and solid material resulting from spraying operations, and failure to provide for the prompt application of large quantities of water to prevent propagation of flame should an incipient fire occur through any cause.

Earlier recommendations contemplated isolation of spraying operations from other work by placing them in a building well separated from other structures. Continuity of operation in a plant may be a controlling factor, in which case the shifting of cars to another structure for application of finishing coatings would be sufficiently inconvenient to prevent serious consideration of the segregation of this work. The rapidity with which coatings can be applied to rolling equipment may in fact be a definite argument in favor of conducting spraying operations in the same building with other painting processes, with due regard, however, to the necessity for eliminating open flame devices and employing all of the safeguards previously outlined in connection with paint spraying operations. It is assumed, therefore, that before any consideration whatever is given to introducing spraying processes into such a shop it will have automatic sprinkler protection as well as other fire protection devices, and that generous water supplies will be available.

When small objects only are to be coated by spraying, a booth of moderate size from which vapors are immediately exhausted through a duct of proper design has been found effective, and the deposits of solid material can be removed from the inside of the structure. The booth principle can be extended to objects of greater length, such as railroad cars, by a modification as to the size of enshrouding structure, with due reference, however, to a radical revision of the ventilating principle. In the small booth the surplus vapors and solid materials resulting from the spraying can be easily removed. In the larger structure or tunnel, as it will be preferably referred to, a single exhaust point would be extremely undesirable, inasmuch as the accumulation of vapors and floating particles at the exhaust end of such a structure would be too highly concentrated. By arranging a series of exhaust points at convenient intervals of 12 to 15 ft., constructing the tunnel in corresponding sections, each with its independent exhaust duct, all of the good features of the small booth are retained, inasmuch as in no case can vapor and dust travel further than half the distance between vents. Horizontal surfaces in ducts accumulate solid material from spraying, hence are to be avoided. Vents, therefore, should each extend vertically and independently a safe distance above the roof of the main structure. In practice, a tunnel for railroad cars would be about 100 ft. long, constructed in seven or eight sections, with the same number of independent vent stacks.

As in the case of small booths, the tunnel structure should be of sheet metal throughout, suitably reinforced with angle irons or channel sections riveted or bolted to the plates outside of the enclosure, in order to assure as smooth interior surfaces as possible. The width of the tunnel should be at least 16 ft., or sufficient to afford operators room to place the necessary scaffold planking from which to work. For the tunnel roof, each section should be treated as an independent canopy, with slopes in four different planes to its vent.

Earlier views as to placing lighting fixtures outside of the tunnel and behind window glass have been materially changed. While each lamp is protected by a glass front in a vapor-tight metal encasement, these lamps are preferably placed in circular openings of approximately the same diameter as the lamp encasement, but at an angle with the side walls of the tunnel so as to permit entrance of air through these partially obstructed openings. The air movement thus produced prevents spraying dust settling on the lighting fixtures.

Previous practice placed an exhaust fan inside the vent at which point cleaning of the blades is not convenient, a condition tending to promote neglect of this important detail. Horizontal surfaces of protecting shields, through which the belt to the fan from the outside motor extends, have also proved undesirable as affording resting places for dust. Direct draught on the aspirating or injector principle has been found practicable, and is obtained by extending a pipe of smaller diameter into the main stack. The end of this pipe, turned up through an elbow and provided with a conical or reducing section in the form of a nozzle, permits air under pressure to pass upward at a fairly high velocity, drawing with it air from the tunnel beneath at a more moderate velocity, sufficiently great, however, to obtain positive exhaust from the interior of the tunnel. In the design of the vents, access doors should be provided for inspection and cleaning purposes.

Associated with the removal of air through the ducts is the introduction of an equivalent air supply, not only through the ends of the tunnel, but at the sides. This is accomplished by permitting the sides of the tunnel to extend only to within 18 in. of the floor or track level. By this simple means, adequate air is supplied and the atmosphere at the level of the operators is freed from vapors.

In no phase of painting work is the necessity for cleanliness more urgent than at spraying booths or tunnels. Surplus material resulting from spraying

operations is bound to be deposited to some extent on the walls and floor of a tunnel. Frequent removal of these deposits is facilitated by extremely simple means. At one time paraffin paper was used on the walls as a temporary lining of booths, as this paper could be removed and burned, together with the accumulated deposits. Later, it was found that automobile soap smeared on the walls was equally effective, and could be washed down daily by the use of hose stream combined with steam jet. Deposits on the floor formerly removed by scraping are now caught on tar paper which can also be removed and burned daily. Should scraping prove necessary, the use of steel implements for the purpose is positively prohibited, in view of the possibility for creation of a spark. Brass or copper scrapers have been found satisfactory, and free from the spark hazard.

Experience has shown that for fires involving pyroxylin coatings the prompt application of water is necessary for cooling effect. While standard automatic sprinklers are necessary throughout the main shop, deluge sprinkler heads operated through a "rate of rise" device, on the principle of local expansion of air inside a copper capillary tube, have been perfected and are now required as a necessary detail of spraying booths and tunnels, as through their use a fire inside the tunnel is almost immediately controlled automatically. Hand release, however, as an auxiliary in operating this system, is also recommended to positively assure against failure of the system through any cause.

From a consideration ot the above, it will be evident that if a paint shop is of good construction and well protected by automatic sprinklers, it will be possible to introduce at reasonable cost a metal structure or tunnel in which spraying of railroad equipment can be conducted safely and efficiently.

Maintenance and care of paint and varnish at terminals

During the last few years there seems to have been a general desire on the part of different railroads to cater more to the comfort of the traveling public in every possible way. This has been manifested by the various improvements in coach construction and also in care in selecting the method of painting, including the use of colors and forms of decorations. As a logical conclusion there should be a system of cleaning and maintenance which would have the equipment in that well-kept condition which conveys to the traveler that sense of pleasure and comfort so essential to the welfare of the railroad. With this idea in view, the committee made the following recommendations, more as general principles from which a system can be employed suitable to the existing conditions peculiar to each location.

Passenger cars

Regular exterior cleaning.—There are two methods by which equipment can be regularly cleaned, one by the use of clean water applied to the surface of the car by various methods and the other, known as the dry method in which the car is wiped over with waste containing a renovating oil and thoroughly wiped dry. The washing of cars should be largely controlled by the local conditions to which the equipment is subjected and in any case this type of washing should be reduced to the minimum as the frequent rubbing combined with the action of the water tends to reduce the resistance qualities of the varnish film, and may lead to considerable damage through peelings, especially noticeable on sash and window batons. If this type of washing is employed, a good method is to use a special constructed brush in which the water is directly supplied through the handle, and finding its way through a perforated front plate which keeps a continuous supply of clean water running thraugh the bristles. It is also desirable to have a rubber edging on any kind of brush used in order to prevent the hard wood of the brush from knocking the surface during the washing. The dry method of regular cleaning should be carefully considered and wherever conditions make it possible, a system of dry cleaning should be resorted to.

Periodical cleaning of exterior.—At the expiration of approximately 90 days, depending entirely on the condition of the car, a periodical cleaning should be in order; this is accomplished by applying a solution of oxalic acid or some reliable car cleaner and thoroughly washed clean. If oxalic acid is used, the solution should be a maximum of 25 lb. of oxalic acid to each 50 gal. of water, the acid to be dissolved in 25 gallons of hot water, and then 25 gal. of cold water added. This solution should be applied when cool with soft hair brushes constructed with a rubber edging, and finally rinsed off with clean water as previously suggested, care taken that all signs of acid and dirt are entirely removed. If a manufactured cleaner is used, it would be advisable to have a sample taken from time to time and analyzed to determine whether the product is safe to be used without having any injurious effect on the varnish film.

Lacquer finished cars.—In cleaning cars with lacquer finish, the method which seems to give the best results is simply to wash with a weak solution of soap, rinse off thoroughly with clean water and wipe dry with chamois skin, if desired.

Renovating.—Cars with a varnish finish, which have received a thorough wash aided by the use of acid cleaners, can be renovated if considered necessary, depending on the nature of the washed surface as regards color and general appearance. There is a difference of opinion regarding the efficiency of this procedure, theobjection taken to the use of the renovator being that dirt will readily adhere to any parts which have not been wiped dry. This is simply an acknowledgment of failure on the part of the workman and could also be applied against the use of acid cleaners or simple soap solutions. The object in applying the renovator in the first place is to counteract any acid which might be left on the surface after washing and principally to restore the glossy appearance of the varnish.

If the renovator is used, a handful of white waste should be moistened with the liquid and rubbed evenly over the surface, after which it should be wiped dry with clean waste. The success of this operation lies in the method in which the renovator is wiped dry and in this connection a great deal depends on the nature of the renovator used, some being more greasy than others and, therefore, require a more thorough wiping.

Interior cleaning.—When the car is having a periodical cleaning the seats ought to be taken out and all dust removed by the use of compressed air, or vacuum system, before starting to wash. The headlinings and all varnished woodwork should be washed with a weak soap solution and carefully rinsed off with clean water, and wiped dry with chamois skins if desired. Extreme care should be taken when mixing the soap

solution, as too strong a mixture will do considerable damage to the varnish film. When rinsing off with clean water, make sufficient changes of the water as it soon becomes dirty, containing a large percentage of soap, which if used continually leaves a soapy scum on the surface. Particular care is necessary in this washing below the window sills, including heater pipes, seat ends and pedestals, as a greater accumulation of dirt settles on these parts. Water should not be allowed to lie on the floors but mopped up immediately and dried thoroughly to prevent possible damage to the floor-paint or the exposed wood to become water soaked. The inside of vestibules should receive the same treatment as the interior of the car, and the floors in toilets after the washing should be gone over with a solution containing

Rubbing down a locomotive tender with a mechanical rubbing device

disinfectant. All varnished woodwork should then be renovated by the same process, care being taken to have the surface thoroughly wiped dry.

Painting of passenger cars at terminals.—It is important to keep the roofs in good condition; there is often considerable damage done to the headlinings caused by leaky roofs which means expensive repairs. If not too extensive, the roof can be made waterproof by the application of a roofing compound. The steps, trucks, etc., can always be kept in good condition by applying the standard color, care being taken that all signs of rust and loose paint are removed by scraping and thorough cleaning with wire brushes. On the body of the car all bare spots on sash, batons, or sheets should be cleaned and painted with the necessary color.

Interior painting.—After each periodical washing, or whenever necessary, all painted parts should be carefully checked up to see if any extensive painting is required. This is especially important with heater pipes and floors. If painting is found to be necessary, all loose substances should be scraped or brushed off the pipes with wire brushes, and all chewing gum removed from the floors before applying the paint. Certain types of cars have the seat ends enameled or lacquered, also from the sills down; in that case, if they are badly marked, they should be touched up and enameled or lacquered as the case may be. Work of this type requires a first-class painter in order to get the work done quickly and with economical results. If this work is done by inexperienced men who have no idea as to the material they are using or how it should be applied they can very easily make the cure worse than the disease, besides being a more expensive proposition in the long run.

Locomotive cleaning and painting

Before a locomotive goes into the enginehouse, after each trip it should be placed on the wash rack and completely cleaned with the washing machine, particular care being given to the drivers, springs and trucks, etc. Where a washing machine is not available the cleaning should be done in the most suitable way and wiped dry. The jackets, cab and tender after being thoroughly cleaned can be renovated if desired with some renovating oil and wiped dry.

Front end painting.—The front end should be painted frequently with the standard front end paint, care being taken that all rust and any paint showing a tendency to scale off is thoroughly scraped and cleaned with wire brushes before applying the paint.

Periodical painting.—Passenger, freight and switch engines should be thoroughly cleaned and painted whenever their condition demands it; this will apply more to the passenger locomotive, where considerable painting is done at enginehouses; there should be some suitable place especially set for this work, so that there is the necessary light, heat and cleanliness necessary to economical and good work.

In this case, the same holds true as with coach yard painting and practical first-class men used for this work to get the best and most economical results.

Cleaning of urinals.—In connection with stains in urinals, this matter should receive strict attention when receiving general repairs. Hoppers should be removed and thoroughly cleaned; stains are sometimes removed by the careful use of muriatic acid, a weak solution of about 1 part acid to 3 parts water being strong enough to remove stains in some cases, depending largely on the quality of the acid.

The cleaning at the terminals should consist of continual washing with soap and water, keeping the surface clean and thereby largely preventing stains. In cases where the enamel surface has been chipped off, these parts should be cleaned, touched up with size and leveled up with white cement putty, rubbed down and touched up with white brushing lacquer.

The report was signed by D. Warner, (chairman), foreman painter, Canadian Pacific; J. J. McNamara, foreman painter, Baltimore & Ohio; F. W. Bowers, foreman painter, Erie; A. C. Boyle, foreman painter, New York, New Haven & Hartford; J. McCarthy, foreman painter, Canadian National; H. E. Brill, general foreman painter, Atchison, Topeka & Santa Fe; B. D. Mason, master painter, Colorado & Southern and R. T. Woods, foreman painter, Grand Trunk.

The Reader's Page

Have You a Question? Ask it
Have You an Opinion? Express it

Both Kempt and Rennie could be more efficient

SPOKANE, WASH.

TO THE EDITOR:

I read with interest General Foreman's letter entitled "Who can settle this argument?", which was published in your September, 1928, issue.

I believe both men in question could be more efficient. Bill Kempt, for instance, should first see that his own department is functioning 100 per cent, and is not behind in its work, and then give his time to other departments to learn from them, if necessary. Then, I believe, he would be a good man, but he cannot be a good man in any department unless he makes that department his first concern, and makes it function.

In the case of Jack Rennie, he has already become proficient in making his department 100 per cent, and he should not confine himself. He certainly has time to broaden himself by studying the other departments, pointing himself to a better position, either as a general foreman or further up the ranks in the mechanical department.

Neither would make a general foreman unless he first made himself proficient in his own department and big enough to study the others.

P. T. O'NEILL,
Division Master Mechanic, C. M. St. P. & P.

What do you think?

MANY department foremen gage the efficiency of their work by comparisons with their record of past performance. How much use do you make of the records and statistics compiled in your office? How much value do you place on statistical information in the management of your department?

The A. R. A. loading rules

PUEBLO, COLO.

TO THE EDITOR:

In view of the usual progressive attitude shown in your editorials, it was rather surprising to note your comment on the Mechanical Division report on the loading rules in the June 27, 1928, issue of the Railway Age, Daily Edition. Regardless of the expressed opinion of the speakers, it is hardly a fact that the rules are "serving their purpose quite efficiently in their present form." And your suggestion that each railroad provide its inspector and the shippers at points loading only one commodity, with a small book containing only the rules and drawings pertaining to that commodity will not help the situation as much as you seem to think.

Both the shipper and the inspectors at such points become familiar with the requirements covering their particular lading and improper loading is resorted to either deliberately or through laxity rather than a lack of knowledge of the rules. But what about the inspector at the busy interchange point who has to pass daily on every conceivable class of commodity with insufficient frequency to be familiar with the loading requirements without referring to the rules?

The rules, in their present form, are too complicated for quick reference. The inspector either invites criticism for delaying his inspection or he makes a necessarily hasty judgment of his own as to the safety of the load and permits it to go forward. Neither procedure is fair to the inspector or the receiving line. Therefore it seems to me that the question merits more thought and intensive study than the committee, or yourself have given it. The following thoughts are given for what they are worth:

1—Would it not be possible practically to double the contents of the present book and still have it in convenient size for car inspectors to carry providing it were made up in the same form as the Bureau of Explosives pamphlet No. 9?

2—The drawings need not be duplicated, but could be grouped in consecutive order in the back of the book.

3—Make one general rule, paragraphed, to cover the requirements which apply to all classes of lading such as brake staff clearance, hand brakes, etc., and make cross reference in the detail rules to this one general rule, thus making duplication of this rule unnecessary in the different sections of the book. The balance of the present general rules applying only to certain lading or methods of loading would necessarily have to be duplicated wherever they apply in the detail rules.

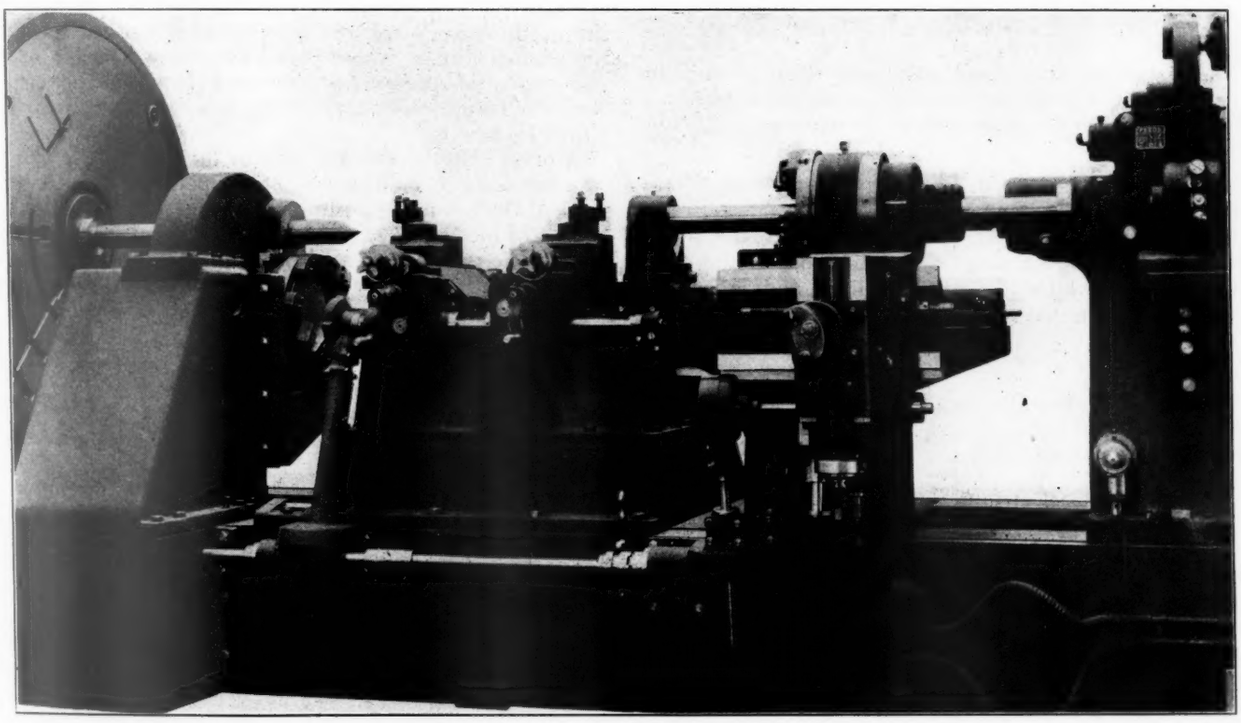
If the committee insists on maintaining the rules in their present form, then why not (in the interest of economy which they so strongly emphasize) eliminate the numerous duplication of certain general rules which now appear throughout the book? Even if the present form is continued, I believe the general rules could be considerably reduced and simplified, thereby reducing cross references to a minimum. The groupings of the drawings in the back of the book would also add to the efficiency of the present book because it is always exasperating when reading a rule to have to finger a half dozen intervening pages of drawings which in most cases do not apply to the particular rule where they are inserted. Many of these groups of drawings occupy five, six and seven leaves in the book.

Much credit is due the Loading Rules Committee for the work they have done and none of the remarks here made are intended to belittle their efforts. Nevertheless, it is apparent that this particular feature has not been given the consideration it deserves.

A READER.

Niles 90-in. axle lathe with special attachments

THE illustrations show a 90-in. locomotive journal turning lathe recently placed on the market by the Niles Tool Works Company, Hamilton, Ohio, for double quartering and crank pin turning, in addition to the turning of inside and outside journals. The capacity of these attachments for the engine stroke is the same as for the quartering attachments; namely, 22 in. minimum and 40 in. maximum stroke. The crank-pin heads will turn pins from 7 in. to 12 in. in diameter, accommodating pins of the maximum length.



Front view of the Niles 90-in. locomotive axle journal lathe equipped for double quartering and crank-pin turning

arrangement for journal turning and quartering has been previously described and illustrated, but these views show the application of crank-pin turning attachments.

The crank-pin heads are of the box tool type and are mounted on heavy bases bolted to the bed, the right-hand head on the base to which the outside journal rest is attached and the left-hand head on an independent base adjacent to the faceplate.

The heads receive their rotation and laterial adjustment from the quartering attachment spindles. The

Burnishing tools, with shanks to fit the tool slots in the crank pin head toolholders are regularly furnished to secure the desired finish after the turning operation.

The illustrations show the machine arranged to handle wheel sets with 90 deg. leads only. The increasing adoption of three-cylinder locomotives with the cranks 120 deg. apart has made it necessary that provision be made for accommodating these wheel sets as well.

Where it is required to double quarter or turn the crank pins of such wheel sets, the right-hand attach-

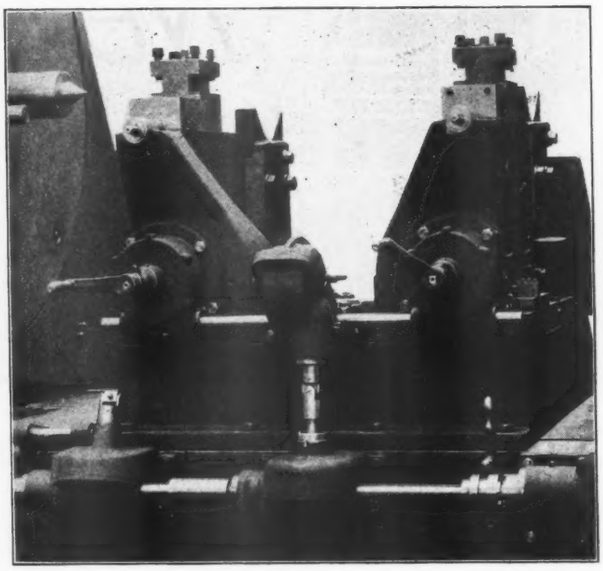
ment is raised and tilted 30 deg. by a filler block. The filler block may be readily detached to bring the quartering frame back to position for wheels with 90-deg. leads. To support the boring bar for quartering and the crank-pin head for pin turning, additional brackets of corresponding heights are supplied, which are secured

The right-hand attachment raised and tilted 30 deg. for double quartering or turning the crank pin of wheel sets for three-cylinder locomotives

to the members used for the same operations on wheels with 90-deg. leads.

Both journals on the center-crank axles for three-cylinder locomotives may be turned at one setting by a special rest, which has narrow slides and is quickly interchangeable with the regular rest. It has power longitudinal feed from the main feed shaft. Cross feed is by hand.

Among the improvements recently incorporated on



A special rest provided for turning both journals on the center-crank axles for three-cylinder locomotives

the machine are steel wearing plates on the bed under the sliding heads. These plates are renewable and are the means of preserving alinement between the two heads, a feature necessary in this type of tool to insure parallel journals.

A brass plate is now attached to the faceplate alongside the balance indicator pointer, upon which may be marked the balancing positions of wheel sets of various classes of locomotives. This is a permanent record and enables the operator to set his counterweight quickly to the correct position when wheels of the same type of locomotive are being handled.

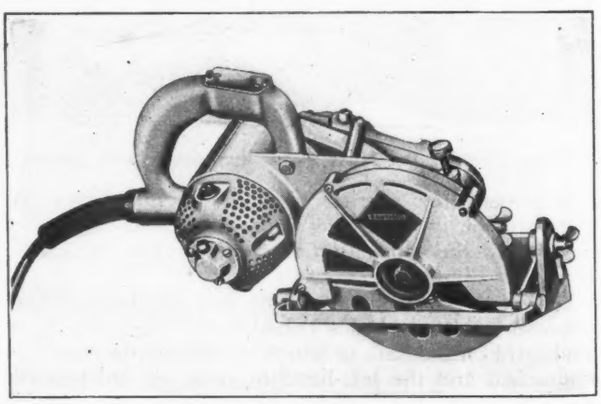
A small electric hand saw

A SMALL electric hand saw, cutting capacity 2 in., equipped with a safety guard, is shown in the illustration. This tool, which is manufactured by the Wappat Gear Works, Inc., 7522 Meade street, Pittsburgh, Pa., requires only one hand to operate and handles easily in any position.

The lower guard, a patented feature, which completely encloses the saw blade, opens gradually by telescoping into the upper guard as the saw is pushed into the material and immediately snaps shut as the cut is finished, thus affording protection to the operator and the saw blade.

The saw is built in three models—one for plain cross cutting, one for bevel cutting, and one with an adjustable dado cutter for grooving. On all three models, the shoe is adjustable vertically, making it possible to set the saw to cut any required depth. The saws cut all kinds of wood, soft metals, Bakelite, fibre and various similar materials used in building and manufacturing processes.

A high-speed universal motor, fan-cooled, mounted on ball bearings, furnishes the power and directs a blast of air to the front of the saw, thus clearing the sawdust away and making it possible to follow a line accurately. The saw shaft, mounted on tapered roller



The Alta electric hand saw equipped for bevel cutting

bearings, is driven by helical gears which are mounted on ball bearings, all completely enclosed and running in grease. A double-pole, non-arc switch is mounted in the handle within easy reach of the operator's forefinger. The frame is all aluminum, highly polished, and all exposed steel parts are rust proofed. Various parts are made of heat-treated aluminum alloy to retain lightness and obtain maximum strength and durability.

A handy steel saw table, 16 in. by 26 in. by 11 in. high, can be furnished, to which the saw can be attached, thereby adding greatly to the range of utility of the saw.

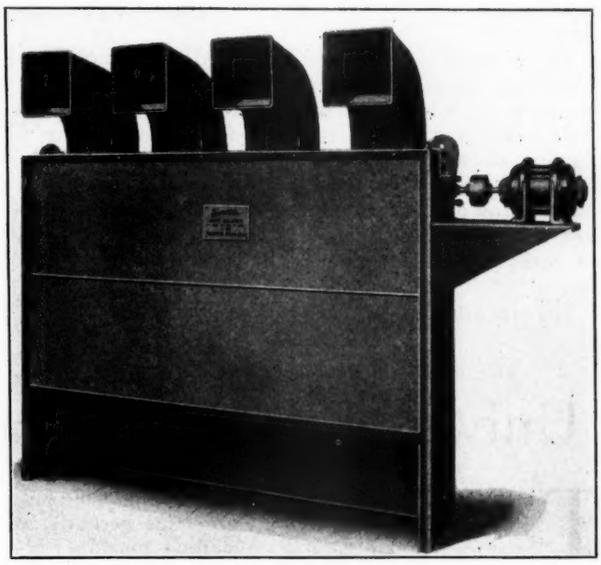
Adaptability features the Sirocco unit heater

AFTER an extended investigation into the advantages and disadvantages of the heating methods employed by the large users of heating apparatus, the research laboratories of the American Blower Corporation, Detroit, Mich., designed the Sirocco unit heater, shown in the illustration. Accessibility is one of the features of the unit heater. The heating element, which is composed of staggered coils of copper fin tubes, expanded into one-piece cast iron headers, is placed into the unit in the form of a drawer, so that it can be easily inspected by removing two locking bolts and easily sliding out the complete heating unit.

The motor is placed in a heavy structural steel saddle mounted on the end of the casing to make inspection and oiling an easy matter. The fan assembly is so arranged that with a few tools it can be lifted out with the shaft and bearings intact.

The unit is strongly constructed, to withstand shop abuse. The end panels of the casings are made of $\frac{3}{16}$-in. pressed steel. A multi-blade fan wheel is used in the unit.

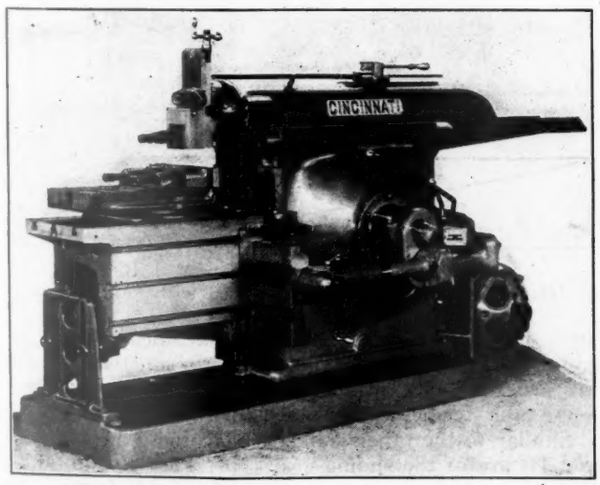
The unit heaters can be furnished in various capacities, sizes and types for all kinds of industrial buildings.



The Sirocco unit heater

Cincinnati rapid traverse shaper

THE Cincinnati Shaper Company, Cincinnati, Ohio, has recently developed a new 36-in. shaper known as the rapid traverse type designed to combine the speed and convenience of a small shaper with the strength and power of a large machine. In this machine the builders have embodied features designed to shorten the set-up time and to permit easy operation. The speed range is from 8 to 102 strokes a minute and the 11 feeds provide a variation of from .010 in. to .170 in. These feeds are changed by a simple, single control. The ram is 6 ft. 4 in. long and the ram bearing in the column is 3 ft. 10 in. long. A full-length taper gib having a single screw adjustment is provided for taking up the ram bearing. The table is provided with a power rapid traverse and all the controls are arranged within a radius of 14 in. of the operating position. The hand feed is equipped with a spring throw-out and quick control indicators enable the operator to see at a glance the feed, speed and the length of the stroke. A revolving table with a rocking top may be applied to this shaper and, when so equipped, it is known as the universal shaper. Some of the more important dimensions and weights of the machine are as follows: Length of stroke, 36¾ in.; horizontal table travel, 30½ in.; vertical table travel, 13 in.; distance from table to ram, 18 in.; table top, 16 in. by 36 in.; depth of table, 20 in.; largest size tools, 1 in. by 2 in.; net weight without motor, 7,900 lb. The motor recommended is one of 10 hp. having a constant speed of 1,800 r.p.m. The machine may be furnished for either pulley or direct drive.



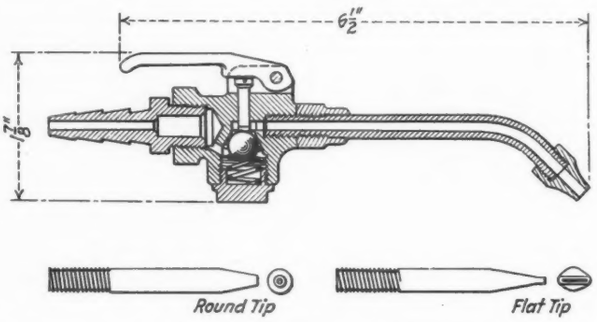
The 36-in. Cincinnati shaper equipped for direct motor drive

Blow valve for cleaning and repair work

THE blow valve shown in the illustration was developed by the New York Air Brake Company, 420 Lexington avenue, New York, for use in all places where air is used for cleaning. It is of simple and durable construction. No parts are used which are liable to get out of order. It is designed to hold under pressure when closed, thus eliminating waste. The valve body is made of bronze. The valve is a rust-proof steel, self-cleaning ball, giving a perfect contact on the seat.

Three styles of tips are furnished with each valve. The long curved tip is fitted with a fibre end, and its use prevents injury to delicate parts, such as slide valve seats. This curved tip is the most convenient form for blowing out small interior ports such as are found in triple valves, feed valves and universal valves. Two shorter tips are furnished for other uses, one having a thin, flat opening and one a circular opening. The tips are easily and quickly changed by backing off the holding nut.

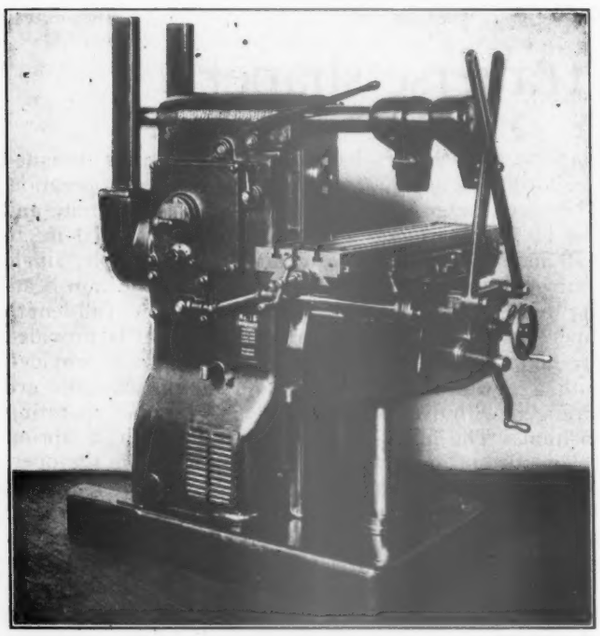
The size and mechanical construction of the valve and handle are such that it can be held comfortably in the hand and be easily and quickly responsive to the press of the lever, freely emitting a volume of air equal to the capacity of the tip openings.



Cross-sectional drawing of a blow valve for use in cleaning air brake equipment

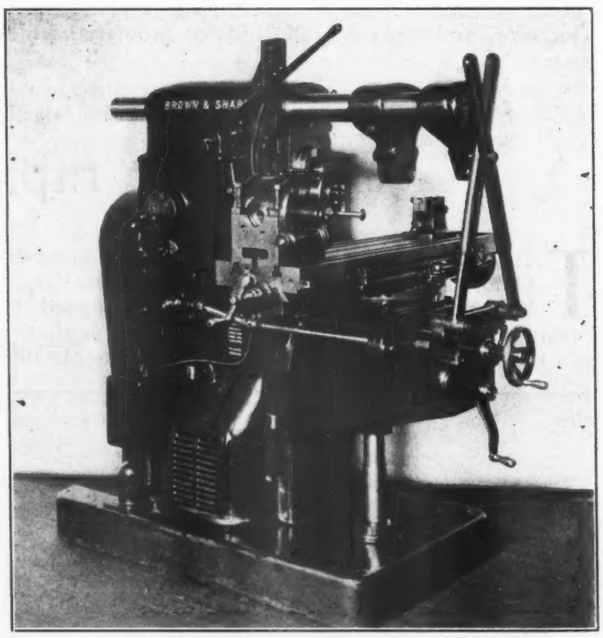
Universal and plain standard milling machines

THE Brown & Sharpe Manufacturing Company, Providence, R. I., has added to its recently introduced line of standard milling machines the No. 1A standard universal and the No. 1B standard plain milling machine. These machines are, in general, similar to the No. 2A and the No. 3A standard universal and the No. 2B and the No. 3B standard plain machines.



No. 1B standard plain milling machine

They have a slightly smaller capacity and are not equipped with the power fast travel feature, dual control for feed changes, and are not furnished with a pump. When desired, both of these features can be furnished as extras. The new machines are of the motor-in-the-base type, double overarm construction, and are provided with an automatic longitudinal and transverse table feed. Vertical feed for the table is by hand.



No. 1A standard universal equipped with motor drive

Similar to the other standard machines, the Nos. 1A and 1B are of the sliding-gear type. They are provided with a single lever for operating the feed changes, located at the front of the machine. Speed changes in the

two series are also obtained by the operation of a single lever on the side of the column. Direct-reading dials in both cases indicate the feed or speed for which the machine is set.

The feed and speed units of the Nos. 1A and IB are driven throughout with heat-treated alloy steel gears which provide a smooth, powerful transmission. The spindle is mounted on three roller bearings, two at the front and one at the rear, and is provided with means for adjustment.

Automatic lubrication throughout is another feature. A pump is provided in the column delivering oil to all mechanism within the column and to the driving pulley. The oil is filtered on each passage through the machine. The knee mechanism is also provided with a pump which furnishes automatic lubrication for the knee assembly.

The knee may be clamped from either the front or rear of the table by a single lever. It is provided with a one-piece knee screw which is completely guarded in all positions and does not extend below the floor. The driving clutch is of the dry multiple-disc type and located outside of the column. It is operated by a single lever on the side of the machine.

The machines are available equipped for belt drive or motor drive.

Texrope drive for Boye & Emmes lathes

ALL sizes of the motor-driven engine lathes, manufactured by the Boye & Emmes Machine Tool Company, Cincinnati, Ohio, may now be equipped at no extra charge with Texrope drive instead of geared

A Boye & Emmes 20-in lathe equipped with Texrope drive

motor drive or motor drive through a flat belt. The illustration shows this drive applied to a 20-in. lathe, but is typical of the arrangement for all sizes which this company builds.

The motor is mounted on a planed pad at the rear of the pedestal and has an adjustment vertically to secure the proper tension of the belts. The drive is designed to utilize a motor of not more than 900 r.p.m.. A guard of wire mesh protects the pulleys and belts.

Some of the advantages of the Texrope drive are the elimination of the idler pulley used in a flat belt drive; a smoother drive owing to the belts being endless and of a more flexible nature; the practical elimination of stretch and slip and the absence of vibration in operation on short centers.

An electric disc sanding tool

CARE has been taken to make the disc sander recently placed on the market by the United States Electrical Tool Company, Cincinnati, Ohio, fully as sturdy and powerful as the other tools in this line. A fan-cooled Universal motor controlled by a two-pole

A well-balanced disc sanding tool that operates at 3,600 r.p.m.

trigger switch, operates the 9-in. disc at 3,600 r.p.m. under load. Ball bearings are used throughout.

Considerable attention has been given to the balance of the disc sander, with the result that it handles easily, making for maximum ease and speed in operating.

Fine, medium and coarse sanding discs are furnished. Also 12-ft. of flexible rubber-covered cable, a two-piece attachment plug and armored cable guard are regular equipment. The weight is only 12 lb.

Starrett high-speed hacksaw blades

THE L. S. Starrett Company, Athol, Mass., has added to its lines of hacksaw blades the No. 840 high-speed blades for hand use and the No. 850 for power sawing. These blades are made of special steel and are designed to speed up production and to increase their useful life. The blades come in 10-in. and 12-in. lengths for hand service, and 12-in., 14-in. and 17-in. lengths for power service.

News of the Month

FIRE CAUSED BY LIGHTNING destroyed the enginehouse of the Missouri Pacific at Lincoln, Neb., on September 12. The estimated loss is $25,000. Three locomotives and a rail motor car were damaged.

A NEW RULE, effective January 1, 1928, prohibiting the use of wood underframes in cars in interchange between roads after January 1, 1931, has been adopted by the Arbitration Committee of the American Railway Association. A ruling, requiring the application of steel underframes on all cars built new, was put into effect on January 1, 1927.

THE CHICAGO, BURLINGTON & QUINCY stores department and shops improved their safety performance in June, 1928, as compared with the same month last year. The 13 shops on the lines east had the same percentage as the year before, 0.34, while the 12 shops on the lines west reduced theirs from 0.19 to 0.13. The last-named percentage is equivalent to one reportable injury for each 790 men employed. Nine of the twelve shops carried 3,346 men through the month without any casualties. The 15 stores on the system averaged one man injured for each 411 workers in June, 1928, compared with one in 213 a year ago.

THE CANADIAN NATIONAL has ordered 20 locomotives of the 4-8-4 Northern type, from the American Locomotive Company through the Montreal Locomotive Works, Ltd. These locomotives are of the same general design as the 6100 class and will be used for both freight and passenger service. An additional order for 10 eight-wheel switching locomotives has been given to the American Locomotive Company through the Montreal Locomotive Works, Ltd., and an order for 15 Santa Fe type locomotives and 10 eight-wheel switching locomotives has been given to the Canadian Locomotive Company.

The railroad also contemplates the purchase of five locomotives of a modified design of the Mountain type now used on main line for both freight and passenger service.

Great Northern equipment-building program

EQUIPMENT CONSTRUCTION work to be done in Great Northern shops this fall and winter will involve an expenditure of approximately $3,000,000, in addition to the appropriation of $1,100,000 for 10 Mountain type locomotives authorized during August. The new work will include the reconstruction and equipping with steel underframes of 2,500 box cars and the construction of 500 automobile box cars, 25 cabooses and 10 locomotive tenders. This is an increase of 500 cars over the number reconstructed last year.

The cars to be rebuilt are of 80,000 lb. capacity. They will be fitted with underframes, friction draft gears, type D couplers, 10-in. air brake cylinders with K-2 triple valves, No. 2 plus brake beams and bands and tie rods. The cost of this work will be between $500 and $600 per car.

The new box cars are of special design, 50 ft. long, of 100,000 lb. capacity, and will cost about $3,000 each. They will be fitted with 12-ft. staggered doors to facilitate the loading of automobiles and machinery. The cabooses will be 25 ft. in length and will also be equipped with steel underframes.

The 10 locomotive tenders will be of 17,000 gal. water capacity, which is the largest capacity tender used on the Great Northern, except on engines hauling ore trains. The large tenders are expected to speed up train movement by eliminating water stops. They will be used on the Montana division on the O-class engines. The tenders will cost approximately $15,000 each. The 10 Mountain type locomotives will cost approximately $110,000 each and will be among the largest locomotives in service in America. With the easy grades along the Great Northern's mountain route, these heavy locomotives will haul the same length trains that are handled on the Prairie divisions where trains are frequently made up of more than 100 cars.

This equipment-building program is in addition to the regular equipment maintenance work carried on by the Great Northern which amounts to approximately $18,000,000 a year.

New record set in fuel efficiency

THE GREATEST EFFICIENCY for any corresponding period on record in the use of fuel by road locomotives was attained by the Class 1 railroads of this country in the first six months of 1928, according to reports just filed by the railroads with the Interstate Commerce Commission.

An average of 131 lb. of fuel was required during the first six months of 1928 to haul 1,000 tons of freight and equipment, including locomotive and tender, a distance of one mile. This was the lowest average ever attained by the railroads since the compilation of these reports began in 1918, being a decrease of four pounds under the best previous record established in the first half of 1927.

The railroads, in the six months period this year, for every pound of coal or its equivalent used, hauled 7.6 tons of freight and equipment one mile. In other words, for every 2.1 ounces of coal, the railroads hauled an average of one ton of freight and equipment one mile.

Class 1 railroads in the first half of 1928 utilized for road locomotive fuel 46,225,638 tons of coal and 1,006,913,475 gallons of fuel oil.

Engineers seek accurate gages as protection to life and property

BECAUSE THE SAFETY of human life often depends upon the accuracy of the pressure gage on a steam boiler or other pressure equipment which can explode, the American Engineering Standards Committee has been asked by the American Society of Mechanical Engineers to approve the establishment of national standards for pressure gages. The standards might provide, for example, for such construction that the gage could not indicate a zero pressure when there is actually sufficient pressure to constitute a grave hazard if a workman should open a boiler or tank—a cause of loss of life in the past. Standardization of vacuum gages is also requested.

Grant of the request by the Standards Committee will be followed by the formation of a committee of technical experts to undertake the work of gage standardization. Besides decreasing the accident hazard, it is expected that the work will benefit manufacturers and purchasers of gages by replacing the great number of sizes and types now being manufactured by a comparatively small number of standard sizes and types based upon the findings of the committee of technical experts.

The United States Navy Department has done much important work in establishing gage standards for the use of the Navy, and several private concerns, such as the Firestone Tire & Rubber Company, the General Electric Company, and the Pennsylvania Railroad, have established specifications for their own use. It is expected that these and other specifications will be studied and co-ordinated in a national way.

The standardization of pressure and vacuum gages may include, in addition to specifications for accuracy and temper-

ature of calibration, such items as ratings of capacity; arrangement of graduations, numerals, indicator hand, and certain features of the interior mechanism; and the position of stop pins. Establishment of standards for test equipment and standard methods for testing gages have also been recommended to the American Engineering Standards Committee.

Long locomotive run on the Rock Island

IN ORDER TO DETERMINE the actual miles possible to be made in continuous passenger service without detaching the locomotive from the train or cleaning its fire en route, the Chicago, Rock Island & Pacific conducted test runs recently with Locomotive 4002 on train No. 5 between Chicago and Limon, Colo., and return on train No. 8 to Goodland, Kan., a total distance of 1,108 miles.

A great deal of comment has, in the past, been made as to the distance which passenger locomotives could run, using different grades of coal, such as Illinois, Iowa and Colorado coals, without fire cleaning and their ability to produce the required steam pressure for on-time movement. It has been said that the Colorado coal could not be used on top of a firebed of Illinois and Iowa coal and steam properly, and serious delays to Rock Island passenger trains Nos. 5, 6, 7 and 8 have occurred in and around Belleville on attempting to run the locomotives from Valley Junction to Limon without fire cleaning, using Iowa coal from Valley Junction to Lincoln, Neb., a distance of 198.9 miles, and Colorado coal the balance of the trip to Limon. Delays were occasioned by having to clean the fire at Belleville and low steam pressure en route west of Omaha on account of dirty fires.

In order to test the possibilities thoroughly, Locomotive 4002, one of the Mountain type passenger locomotives in the passenger pool between Chicago and Valley Junction and, on the date set for the test trip, available at the Forty-seventh street terminal, was dispatched on its turn on train No. 5 the night of July 12. This locomotive had to its credit at the time of test 55,000 engine miles, and was in generally good condition, nothing special having been done to it to prepare it for this test. It was simply given the regular roundhouse attention.

The locomotive continued through to Limon, arriving there on the morning of July 14, was turned on the wye and attached to train No. 8 on the same date, and returned to Goodland without having its fire cleaned. Illinois coal was burned, Chicago to Valley Junction, Iowa coal from Valley Junction to Lincoln, and Colorado coal from Lincoln to Limon and back to Goodland. The total distance was 1,108 miles without having the fire cleaned, and the condition of the locomotive and fire in the firebox at the completion of the trip was 100 per cent. Maximum boiler pressure was maintained during the entire trip.

On arrival at Goodland, on train No. 8, the locomotive was detached, put into the roundhouse and given the usual roundhouse attention, including a boiler wash; dispatched on train No. 5, Sunday, July 15; ran to Limon, Colo.; detached; turned on the wye and attached to train No. 8 the same date, leaving Limon and running to Chicago, a distance of 1,108 miles, without the fire having been cleaned. It arrived at Chicago in 100 per cent condition, and with the fire in such shape that it could have made many more miles without cleaning. During the entire round trip the locomotive is said to have run perfectly cool and maintained full boiler pressure at all times.

During the difficult trip westbound on train No. 5 to Limon, eight tons of Illinois coal were burned from Chicago to Rock Island, nine tons of Iowa coal from Rock Island to Valley Junction, nine tons of Iowa coal from Valley Junction to Council Bluffs, and four tons of Iowa coal from Council Bluffs to Lincoln, a total of 30 tons of coal. The fire was in good steam-making condition on arrival at Lincoln, where the first of the Colorado coal was taken, and during the rest of the run to Limon-Goodland the fire steadily improved, thus successfully burning the Colorado coal on top of the Illinois and Iowa firebed. The total amount of coal used on the trip from Chicago to Limon-Goodland was 58 tons. The total time on the road was 30 hours and 24 minutes. The ash pan was cleaned at the terminals where enginemen changed. The locomotive was in charge of seven engine crews during the trip from Chicago to Limon and Goodland on trains Nos. 5 and 8, and seven engine crews were used on the return trip. Because of the splendid condition of the locomotive feed water, the boiler did not show any signs of foaming or raising its water above normal for the entire run of 1,108 miles.

Locomotive 4002 is equipped with the Northern Pacific type perforated table grates, and in order to demonstrate that this run could be duplicated, Locomotive 4032, equipped with Rock Island finger type grates, was attached to train No. 5 at Chicago on July 31, and ran to Limon, arriving at that point on the morning of August 2, on time, turned on wye, and was attached to train No. 8 on the same date, arriving at Goodland at 4:05 p.m., on time. It arrived at and departed from all terminals, Chicago to Limon and Goodland, on time and in a 100 per cent condition. The locomotive is hand-fired.

Meetings and Conventions

President Budd addresses mechanical engineers

MECHANICAL DEVELOPMENTS and improvements in railway operation during the last eight years, contributed by the engineering profession, have enabled the railways to give the best service they have ever given, and at prices lower than ever before, when measured in terms of prices of other commodities, said Ralph Budd, president of the Great Northern, in a recent address at the annual dinner of the American Society of Mechanical Engineers at St. Paul, Minn. Employees have never enjoyed as favorable working conditions as at present, and never before have the railroads been in such splendid physical condition.

"Although railroad expansion in the United States is nearly over, the roads have added about $6,000,000,000 to their national investment since the World War. This money, which amounts to about one-fourth the total railway investment in the country, was expended for improving existing railroad plants. There are now no more locomotives and cars and practically no more railroad lines in the United States than in 1920. If the railroads had not been able to use the mechanical improvements produced by the engineering profession, freight charges would have been higher, or wages would have been lower, or the roads would have ceased to pay dividends. There was no alternative for the railroads; the cost of operation had to be reduced."

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs.

AIR-BRAKE ASSOCIATION.—T. L. Burton, 165 Broadway, New York. Next meeting, April 30-May 3, 1929, at Stevens Hotel, Chicago.

AMERICAN RAILWAY ASSOCIATION DIVISION V.—MECHANICAL.—V. R. Hawthorne, 431 South Dearborn St., Chicago.

DIVISION V.—EQUIPMENT PAINTING SECTION.—V. R. Hawthorne, Chicago. Next meeting Windsor Hotel, Montreal, September 11-13.

DIVISION VI.—PURCHASES AND STORES.—W. J. Farrell, 30 Vesey St., New York.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—G. G. Macina, 11402 Calumet avenue, Chicago.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Railroad Division, Marion B. Richardson, associate editor, *Railway Mechanical Engineer*, 30 Church St., New York.

AMERICAN SOCIETY FOR STEEL TREATING.—W. H. Eiseman, 7016 Euclid Ave., Cleveland, Ohio. Annual convention October 8-12, Benjamin Franklin Hotel, Philadelphia, Pa.

AMERICAN SOCIETY FOR TESTING MATERIALS.—C. L. Warwick, 1315 Spruce St., Philadelphia, Pa.

AMERICAN WELDING SOCIETY.—Miss M. M. Kelly, 29 West Thirty-ninth street, New York. Fall meeting, October 8-12, Bellevue-Stratford Hotel, Philadelphia, Pa.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS.—Joseph A. Andrucetti, C. & N. W., Room 411, C. &. N. W. Station, Chicago, Ill. Annual meeting, October 23-26, Hotel Sherman, Chicago.

CANADIAN RAILWAY CLUB.—C. R. Crook, 129 Charon St., Montreal, Que. Regular meetings, second Tuesday in each month, except June, July and August, at Winudsor Hotel, Montreal, Que. Next meeting October 9 at 8:15 p.m. Baldwin night. A talk by W. A. Austin will be illustrated by films.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—Aaron Kline, 626 N. Pine Ave., Chicago, Ill. Regular meeting second Monday in each month, except June, July and August, Great Northern Hotel, Chicago. Next meeting. October 8 at 8 p.m. at Hotel Morrison, Chicago. Annual meeeting. Election of officers, entertainment and dance.

CAR FOREMEN'S ASSOCIATION OF ST. LOUIS.—A. J. Walsh, 5874 Plymouth Apt. 18, St. Louis, Mo. Regular meeting first Tuesday in each month, except June, July and August, at Broadview Hotel, East St. Louis, Ill. Next meeting October 9 at 8 p.m. W. H. Davies,

superintendent air brakes, Wabash, will speak on the standardization of freight car brakes.

CAR FOREMEN'S CLUB OF LOS ANGELES.—J. W. Krause, 514 East Eighth St., Los Angeles, Cal. Meeting second Friday of each month in the Pacific Electric Club building, Los Angeles, Cal.

CENTRAL RAILWAY CLUB.—H. D. Vought, 26 Cortlandt St., New York. Regular meetings second Tuesday each month, except June, July and August, at Hotel Statler, Buffalo.

CHIEF INTERCHANGE CAR INSPECTORS' AND CAR FOREMEN'S ASSOCIATION.—See Master Car Builders' and Supervisors Assn.

CINCINNATI RAILWAY CLUB.—D. R. Boyd, 3328 Beekman St., Cincinnati. Regular meeting second Tuesday, February, May, September and November.

CLEVELAND RAILWAY CLUB.—F. L. Frericks, 14416 Adler Ave., Cleveland, Ohio. Meeting first Monday each month, except July, August and September, at Hotel Hollenden, East Sixth and Superior Ave.

INTERNATIONAL RAILROAD MASTER BLACKSMITHS' ASSOCIATION.—W. J. Mayer, Michigan Central, 2347 Clark Ave., Detroit, Mich.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—L. G. Plant, Railway Exchange, 80 E. Jackson Boulevard, Chicago. 1929 Annual Meeting Hotel Sherman, Chicago, May 7-10, inclusive.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 1061 W. Wabash Ave., Winona, Minn. Annual convention Hotel Sherman, Chicago, September 18-21, 1928.

LOUISIANA CAR DEPARTMENT ASSOCIATION.—L. Brownlee, 3212 Delachaise street, New Orleans, La. Meetings third Thursday in each month.

MASTER BOILERMAKERS' ASSOCIATION.—Harry D. Vought, 26 Cortlandt St., New York. Annual meeting May 21-24, 1929, Hotel Biltmore, Atlanta, Ga.

MASTER CAR BUILDERS' AND SUPERVISORS' ASSOCIATION.—A. S. Sternberg, master car builder, Belt Railway of Chicago, Chicago.

NEW ENGLAND RAILROAD CLUB.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Regular meeting second Tuesday in each month, excepting June, July, August and September, Copley-Plaza Hotel, Boston. Next meeting October 9 at 6:30 p.m. W. K. Hullett, general manager, Bangor & Aroostook, will speak on transportation and potatoes. Entertainment during dinner.

NEW YORK RAILROAD CLUB.—H. D. Vought, 26 Cortlandt St., New York. Meetings third Friday in each month, except June, July and August, at 29 West Thirty-ninth St., New York.

PACIFIC RAILWAY CLUB.—W. S. Wollner, 64 Pine St., San Francisco, Cal. Regular meetings, second Tuesday of each month in San Francisco and Oakland, Cal., alternately.

RAILWAY CAR DEPARTMENT OFFICERS' ASSOCIATION.—See Master Car Builders and Supervisors' Association.

RAILWAY CLUB OF GREENVILLE.—Paul A. Minnis, Bessemer & Lake Erie, Greenville, Pa. Meeting third Thursday of each month, except June, July and August. Next meeting October 16 at 6 p.m. The paper to be presented is entitled "Neck of the bottle," being a demonstration of the dispatcher control installation on the Pere Marquette.

RAILWAY CLUB OF PITTSBURGH.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa. Regular meeting fourth Thursday in month, except June, July and August. For Pitt Hotel, Pittsburgh, Pa.

ST. LOUIS RAILWAY CLUB.—B. W. Frauenthal, M. P. O. Drawer 24, St. Louis, Mo. Regular meetings, second Friday in each month, except June, July and August.

SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.—A. T. Miller, P. O. Box 1205, Atlanta, Ga. Regular meetings third Thursday in January, March, May, July, September and November. Annual meeting third Thursday in November, Ansley Hotel, Atlanta, Ga.

SOUTHWEST MASTER CAR BUILDERS AND SUPERVISORS ASSOCIATION.—See Master Car Builders' & Supervisors' Association.

TRAVELING ENGINEER'S ASSOCIATION.—W. O. Thompson, 1177 East Ninety-eighth St., Cleveland, Ohio.—Annual meeting Hotel Sherman, Chicago, September 25 to 28 inclusive.

WESTERN RAILWAY CLUB.—W. J. Dickinson, 189 West Madison St., Chicago. Regular meetings, third Monday in each month, except June, July and August. Next meeting October 15, at 8 p.m. Paper on automatic train control will be presented by J. A. Peabody, signal engineer, Chicago & North Western.

* * *

The D. L. & W. passenger car storage yard at the Hoboken terminal

Supply Trade Notes

THE AIR REDUCTION COMPANY, Inc., has purchased the business and property of the Ohio Oxygen Company, Niles, Ohio.

LAWRENCE A. CARPENTER, for the past ten years railroad sales manager of the Tousey Varnish Company, Chicago, has been promoted to sales manager, in charge of all sales.

AUGUST WILKS has been appointed works manager of the Kearney & Trecker Corporation, Milwaukee, Wis., and C. M. Cheadle, Jr., has been appointed advertising manager.

L. O. CAMERON, Munsey building, Washington, D. C., has been appointed special railroad representative in the Central Atlantic district, for the Baker-Raulang Company, Cleveland, Ohio.

LINDSAY C. PRITNER, assistant superintendent of the car department of the Bethlehem Steel Corporation, has been appointed superintendent of that department, succeeding Benjamin F. Faunce, resigned.

EDWARD S. SULLIVAN has been appointed special coast representative for the St. Louis Car Company, with headquarters at San Francisco, Cal., and will assist Gus Koch, coast agent, who is absent because of illness.

THE UNITED STATES ELECTRICAL TOOL COMPANY, Cincinnati, Ohio, has opened a branch office at 1641 Stout street, Denver, Colo., in charge of L. B. Putnam. J. R. Baumberger has been appointed representative at Dallas, Tex.

HAL F. WRIGHT has been appointed assistant to the general manager of sales of the American Chain Company, Inc., and associate companies, with headquarters at Bridgeport, Conn. Mr. Wright also continues his former duties.

THE UNITED STATES ELECTRICAL TOOL COMPANY, Cincinnati, Ohio, has opened a branch office at 1641 Stout street, Denver, Colo., in charge of L. B. Putnam. J. R. Baumberger has been added to the company's personnel at Dallas, Tex.

THE SYNTRON COMPANY, Pittsburgh, Pa., has appointed the following district sales managers: W. F. Delaney, 203 Mutual building, Richmond, Va.; A. C. Heath, Jr., 706 Globe building, St. Paul, Minn., and M. N. Thackaberry, 308 East Third street, Los Angeles, Cal.

JOHN H. RODGER has resigned as vice-president of the Safety Car Heating & Lighting Company to become associated with the Union Carbide & Carbon Corporation. Mr. Rodger retains his interest in the affairs of the Safety Company and will continue as a member of its board of directors.

J. F. HOERNER, assistant to vice-president of the Baldwin Locomotive Works at New York, has been appointed manager, in charge of the New York office of the Baldwin Locomotive Works and the Standard Steel Works Company, succeeding James McNaughton, vice-president, deceased.

JOSEPH T. RYERSON & SON, INC., Chicago, has acquired the plant, merchandize and good will of the E. P. Sanderson Company, Cambridge, Mass. Both the Ryerson and Sanderson companies have specialized in iron and steel products, such as bars, shafting, I-beams, boiler tubes, rivets, angles, tees, etc.

HOWARD F. KULAS, secretary and in charge of production and manufacturing of the Midland Steel Products Company, Cleveland, Ohio, has been appointed vice-president in charge of sales and J. E. Maloney, sales manager of the Cleveland division, has been appointed general sales manager, succeeding W. G. Langdon, resigned.

THE TIMKEN ROLLER BEARING COMPANY has announced the incorporation of a new company, known as the Timken Steel & Tube Company, which will take over the manufacture and selling of Timken steel and tubing. The headquarters and mills are in Canton, Ohio, with sales offices in Chicago, Los Angeles, Detroit, and New York.

GEORGE M. HASKELL, who has been in the service of the J. G. Brill Company since May, 1894, died at the Engineers' Club, New York City, on September 22. Mr. Haskell was a sales representative in the electric railway division and, for the past several years, had devoted most of his time to the cities of New York and Boston.

E. J. PHILLIPS, who has represented, the Van Dorn Electric Tool Company, Cleveland, Ohio, in the sale of its products at Detroit, is now located at San Francisco, Cal., having taken over that territory for the same company. He is succeeded in Michigan by George Phillips, and J. F. Spaulding has been transferred to the Baltimore territory to take the place of J. Beggs, who has been transferred to the main office at Cleveland.

HORACE M. WIGNEY has been appointed manager of Safety Refrigeration, Inc., with office at 75 West street, New York. This is the subsidiary of The Safety Car Heating & Lighting Company which controls the use of Silica Gel for refrigeration in connection with transportation. Mr. Wigney was born in Chicago on May 7, 1882, and began railway work in the transportation department of the Illnois Central in 1899, as car distributor. From 1903 until 1906, he served as general car accountant for the Cold Blast Transportation Company, also the Doud Stock Car Company, at Chicago. When the Pacific Fruit Express Company was organized in 1906, he went with that company as car accountant and later served as assistant to the vice-president and general manager, also as superintendent of transportation in charge of all of its activities east of the Missouri river. In 1915, he became vice-president of the Dairy Shippers' Dispatch and later was elected president of that company. In 1917, the entire equipment of this company was sold to the American Refrigerator Transit Company. Mr. Wigney then spent considerable time in South America studying conditions relating to railroad transportation and the movement of perishable products under refrigeration. In 1922, he was appointed general manager of the Western Refrigerator Car Line, which was formed to operate over the Western Pacific and its connections, this company later being merged with the Pacific Fruit Express Company. In June, 1923, when the Merchants Dispatch Refrigerator Line was organized to operate over the New York Central Lines and its connections, he entered the service of that company as superintendent of car service. He later became general superintendent of transportation. He served in this capacity until June, 1927, when he resigned to enter other business in California.

Horace M. Wigney

THE PAIGE & JONES CHEMICAL COMPANY of New York City and Hammond, Ind., has purchased from the American Water Softener Company, Philadelphia, patent rights and good-will pertaining to the lime soda water softening business of that company, and will hereafter manufacture and sell this type of lime soda water softeners. W. T. Runcie, formerly sales manager, and H. C. Waugh, engineer of the American Company, have joined the organization of the Paige & Jones Chemical Company.

JOSEPH E. BROWN, who has been elected vice-president of the Central Valve Manufacturing Company, with headquarters in the Railway Exchange building, Chicago, was born at New York on December 6, 1886. After graduating from high school he entered the purchasing department of the Erie and, in 1910, became western railroad manager of the Standard Paint Company, now the Rubberoid Company. In 1918 he entered the employ of the O'Malley Beare Valve Company, now the Central Valve Manufacturing Company, as eastern sales manager, with headquarters at New York. He was holding this position at the time of his recent election.

THE ELLCON COMPANY, New York City, has been appointed general sales representative for Peacock staffless brakes in the United States, Canada and foreign countries. This announcement has been made by Frank D. Miller, president of the National Brake Company, Buffalo, N. Y., manufacturer of the Peacock brakes. The Ellcon Company, since its organization in 1910, has specialized in passenger car equipment devices. The Peacock brake is used on both passenger and freight equipment. William Wampler, president of the Ellcon Company, will devote particular attention to this phase of the company's activity.

DONALD C. DAVIS, mechanical engineer of the Gould Coupler Company, Depew, New York, died July 31 at his residence in Buffalo, N. Y. Mr. Davis was born on Dec. 1, 1878. He was graduated from Masten Park high school and served during the Spanish American War in the 202nd Regiment, from which he was discharged in 1901. He was in the employ of the Niagara Lockport & Ontario Power Company as a draftsman during 1906 and 1907 and afterwards with the Gould Storage Battery Company until the fall of 1908. He was transferred to the Gould Coupler Company as chief draftsman in 1909 and, in 1924, was promoted to mechanical engineer.

RAYMOND E. MILLER, assistant chief engineer of the Westinghouse Air Brake Company at Wilmerding, Pa., has been appointed general manager of the same company, succeeding the late F. H. Parke. Mr. Miller has been connected with the Westinghouse Air Brake organization for the past 22 years. He entered the company's service as a special apprentice immediately after his graduation as electrical engineer from the Michigan University in 1906. During the succeeding years he advanced rapidly from one position to another, until he was appointed assistant chief engineer in 1926 His work has largely been devoted to air brake trials and tests of newly developed air brake improvements in their practical application.

Raymond E. Miller

R. K. WEBER, vice-president of the Mt. Vernon Car Manufacturing Company, Mt. Vernon, Ill., has been elected president to succeed W. C. Arthurs, deceased, and will be succeeded by H. H. Cust, assistant to the president. Mr. Arthurs, Vernon Car Manufacturing Company, Mt. Vernon, Ill., who died suddenly on September 16, was born in Montgomery county, Ill. After being engaged in the manufacture of shoes at Dekalb, Ill., he entered the employ of the Litchfield Car & Machine Company in 1887 as cashier and paymaster, which position he held during the ensuing two years. In 1890 he became secretary and treasurer of the Mt. Vernon Car Manufacturing Company and, in 1897, was appointed receiver by the court. In 1902 he was appointed vice-president and treasurer, and, in 1908, was elected president.

Personal Mention

General

J. D. MUIR, assistant works manager of the Angus shops of the Canadian Pacific, at Montreal, Que., has been promoted to assistant superintendent of motive power and the car department, with headquarters at Winnipeg, Man.

HUGH H. BOYD, assistant chief mechanical engineer of the Canadian Pacific at Montreal, Que., has been appointed asssitant chief of motive power, with headquarters at the same city.

WILLIAM A. NEWMAN, mechanical engineer of the Canadian Pacific at Montreal, has been appointed chief mechanical engineer, with headquarters at the same point.

Master Mechanics and Road Foremen

WALTER A. BENDER, mechanical inspector of the Missouri Pacific at St. Louis, Mo., has been promoted to master mechanic, with headquarters at Nevada, Mo., succeeding V. H. Winnberg, who has been assigned to other duties.

THE HEADQUARTERS OF W. T. Fitzgerald, master mechanic of the Nebraska-Colorado division of the Chicago Rock Island & Pacific, have been moved from Goodland, Kan., to Fairbury, Neb.

D. W. CAMPBELL, master mechanic of the Canadian National at Winnipeg, Man., has been transferred to the Kamloops division of the British Columbia district, with headquarters at Kamloops, B. C., to succeed E. E. Austin, who has retired.

Shop and Enginehouse

R. H. MCCARTY, lead machinist, has been promoted to the position of valve motion foreman, with headquarters at Paducah, Ky.

D. J. DEE, division foreman of the Missouri Pacific at Sedalia, Mo., has been appointed general foreman, with headquarters at Monroe, La.

FRANCIS RIPLEY, gang leader of the Norfolk & Western at Shaffer's Crossing, Va., has been promoted to the position of assistant foreman, with headquarters at Eckman, W. Va., succeeding F. E. Simmerman.

E. L. PETERS, assistant foreman of the Norfolk & Western at Bluestone, W. Va., has been promoted to the position of assistant general foreman, with headquarters at Bluefield, W. Va., succeeding H. W. Reynolds.

Purchases and Stores

C. E. KELSEY has been appointed purchasing agent of the Denver & Salt Lake, with headquarters at Denver, Colo.

H. W. NELSON has been appointed purchasing agent of the New Orleans Great Northern, with headquarters at New Orleans, La.

LAMBERT N. HOPKINS has retired as purchasing agent of the Chicago, Burlington & Quincy, with headquarters at Chicago. Mr. Hopkins, at the time of his retirement, had been in the service of the C. B. & Q. continuously for 43 years, 23 years of which he spent as purchasing agent.

GEORGE W. CONWAY, who has retired as general storekeeper of the Louisville & Nashville, with headquarters at Louisville, Ky., had been in the service of that railroad for nearly 47 years. He was born on March 10, 1858, and entered the service of the Louisville & Nashville on August 2, 1881, in a clerical capacity. After advancing through various positions on the L. & N. during the next 23 years, Mr. Conway became assistant general storekeeper, with headquarters at Louisville in 1904. He was promoted to the position of general storekeeper on January 1, 1916.

Car Department

D. FULK, car foreman of the Southern, has been appointed general car foreman, with headquarters at Alexandria, Va.

J. W. BENNET, lead man of the Illinois Central, has been promoted to the position of wheel and cabinet foreman, with headquarters at Paducah, Ky.

WILLIAM J. FAHEY, car foreman of the Chicago, Rock Island & Pacific at Estherville, Iowa, has retired after over 46 years continuous service.

Obituary

F. F. SMALL, special mechanical engineer of the Southern Pacific at San Francisco, Cal., died at his home at San Anselmo, Cal., on July 22 after an illness of long duration.

WILLIAM A. PARKER, purchasing agent of the Bessemer & Lake Erie and the Union, with headquarters at Pittsburgh, Pa., died on August 6 at Hesston, Huntingdon County, Pa. Mr. Parker entered the service of the Bessemer & Lake Erie in August, 1897, as a stenographer in the purchasing department and, in December, 1904, was appointed purchasing agent. He also served in the same capacity for the Union Railroad.

FLOYD E. PATTERSON, director, secretary and treasurer of the American Steel Foundries died on August 12 at St. Luke's hospital, Chicago. He was also a director and vice-president of the Griffin Wheel Company, a director and vice-president of the Damascus Brake Beam Company, and a director and president of the Galesburg Malleable Castings Company. He was born on March 13, 1859, at Yorktown, Ill., and devoted practically all of his career to the steel and allied industries. On the formation of the American Steel & Wire Company in 1898, he became assistant secretary and New York office manager of that corporation. When the American Steel Foundries was incorporated in 1902 he was elected secretary and treasurer of that company, which position, together with that of a director, he held until his death.

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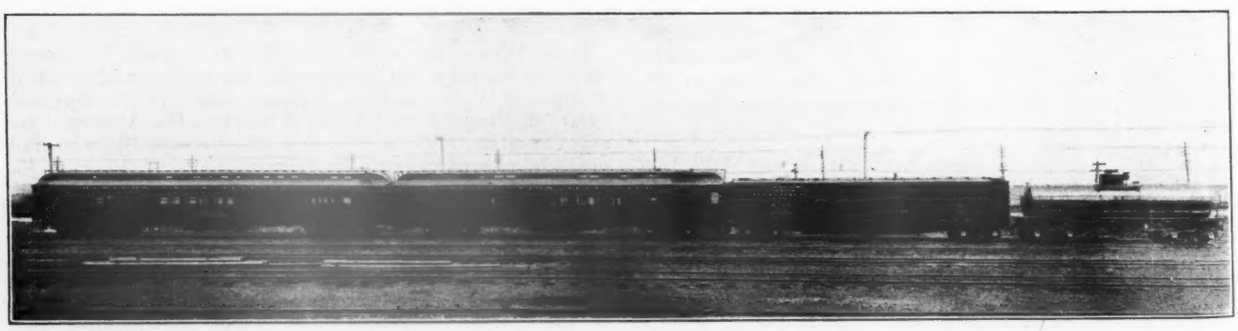

Four different types of cars used by the Western Union Telegraph Company for its construction forces